# Syllabus

## SOCCA 29th Annual Meeting and Critical Care Update

May 20, 2016

Hilton San Francisco Union Square

San Francisco, California

Society of
Critical Care Anesthesiologists
SOCCA

www.socca.org

# Syllabus Content

1. Final Program

2. Abstract Submissions

3. Session Handouts

4. Disclosure to Learners

# Final Program

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# Welcome to the SOCCA 29th Annual Meeting and Critical Care Update in San Francisco, California!

## SOCCA Education Session Highlights

**The Anesthesiologist-Intensivist and the Current Era of Healthcare Reform**

- The Anesthesia Quality Institute and ICU Metrics
- Bundled Payments-What Does This Mean for the Intensivist?
- Critical Care Organizations in Academic Medical Centers

**Big Data in Critical Care**

- Big Data Defined: What Does It Really Mean for Quality Management in the ICU
- Challenges in the Use of Big Data in the ICU
- MIMIC-2 Project

**Trials You Should Be Aware Of: An Update from the Critical Care Research Networks**

- US Critical Illness and Injury Trials Group (USCIITG)
- The PETAL Clinical Trials Network
- Canadian Critical Care Trials Group

**Update on Devices for the Failing Organ in the ICU**

- Cardiac
- Assist Devices to Support the Failing Lung
- Liver Support and Liver Replacement: Ready for Prime Time?

## Focus On Critical Care at the IARS 2016 Annual Meeting and International Science Symposium

The Society of Critical Care Anesthesiologists will again hold their 29th Annual Meeting and Critical Care Update in conjunction with the International Anesthesia Research Society (IARS) 2016 Annual Meeting and International Science Symposium in San Francisco, California.

Take advantage of a solid two-day education program, beginning with the SOCCA Annual Meeting on Friday, May 20 and continuing with a day of SOCCA supported sessions focused on critical care at the IARS 2016 Annual Meeting on Saturday, May 21.

## *Take advantage of some of the best free things to do while you are visiting San Francisco**

SAN FRANCISCO California

- Take a Free Guided Walking Tour. With over 90 tours to choose from—Murals and the Multi-Ethnic Mission, Castro: Tales of the Village, or Gold Rush City, to name a few—San Francisco City Guides is one of the best deals in town.
- Tour City Hall. Come see where, in 2004, Mayor Gavin Newsom made his bold statement to the country about the future of same-sex marriage in this beautiful Beaux Arts building. Free tours are offered to the public.
- Browse the Ferry Building Farmers' Market. Stroll booth to booth sampling organic food. Buy fresh produce alongside some of the big name chefs of the Bay Area. People watch. It is always a party and always free. Held rain or shine every Tuesday, Thursday, and Saturday, this is one of the most pleasurable ways to spend time the city.
- Visit the Wells Fargo Museum. Have a look at pistols, mining equipment, an original Wells Fargo stagecoach, old photographs, other gold rush-era relics at the bank's original location.
- Hang Out in Golden Gate Park: Stroll around Stow Lake, watch the disco roller skaters who dance around the area closed to traffic on Sundays, hang out in Shakespeare's Garden, or just find a sunny patch of grass to call your own. There's tons to do in the city's communal backyard that doesn't cost a cent.
- Take Advantage of Free Culture Days. Most every museum in San Francisco opens its doors to the public for free on certain days of the week

*As seen in Frommers **http://goo.gl/lpkpgD**

For more information on what to do in San Francisco click here: **https://goo.gl/xKFrx1**


# SOCCA Committee on Education

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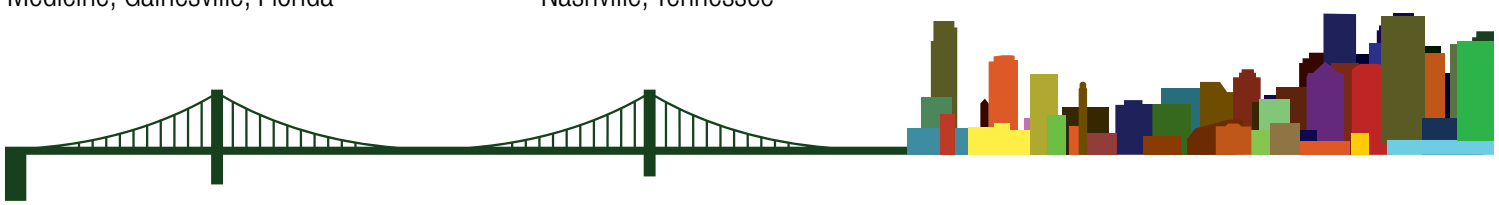

# SOCCA 2016 Annual Meeting Faculty and Moderators

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# Continuing Medical Education (CME) Activity Information

### Activity Overview
The Society of Critical Care Anesthesiologists (SOCCA) 29th Annual Meeting and Critical Care Update is designed to optimize outcomes for critically ill patients and their families through evidence-based and clinically-oriented physician education. The purpose of the SOCCA Annual Meeting and Critical Care Update is to advance knowledge, improve competence, and enhance performance of intensive care teams.

### Target Audience
The SOCCA 29th Annual Meeting and Critical Care Update is designed for anesthesiologists in the clinical and laboratory setting.

### Educational Objectives
As a result of participating in this CME activity, learners should be able to:

- Evaluate the current state of emerging knowledge and practice patterns and assess the relevance to their professional practice;
- Incorporate new knowledge from advances in anesthesiology practice into their professional practice areas; and
- Distinguish gaps in their knowledge, behavior, and patient outcomes that may result in a need for additional education and training.

### Accreditation Statement
This activity has been planned and implemented in accordance with the accreditation requirements and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of the International Anesthesia Research Society (IARS) and the Society of Critical Care Anesthesiologists (SOCCA). The IARS is accredited by the ACCME to provide continuing medical education for physicians.

### CME Credit
The International Anesthesia Research Society (IARS) designates this live activity for a maximum of 6 *AMA PRA Category 1 Credits.™* Physicians should claim only the credit commensurate with the extent of their participation in the activity.

### Claiming CME Credit
SOCCA will provide online program evaluation and session tracking to support claiming CME credit immediately following the close of the live activity.

### Disclosure
The International Anesthesia Research Society (IARS) makes every effort to develop CME activities that are independent, objective, scientifically balanced presentations of information. The IARS has implemented mechanisms requiring everyone in a position to control content to disclose all relevant financial relationships with commercial interests. Relevant financial relationships are defined as financial relationships in any amount occurring within the past 12 months, including financial relationships of the spouse or partner of the person in control of content. Disclosure of any or no relationships is made available in advance of all educational activities. The IARS evaluates, and if necessary, resolves any conflicts of interest prior to the start of the activity. Individuals who refuse or fail to provide the required disclosures are disqualified from being a planning committee member, teacher, or author of CME, and cannot have control of, or responsibility for, the development, management, presentation or evaluation of the CME activity.

It is IARS policy that an employment relationship with a commercial interest presents an inherent conflict of interest that cannot be resolved successfully with respect to CME activities. Therefore, employees of commercial interests are prohibited from serving in any position to control CME content (planner, reviewer, presenter, speaker, moderator, etc.).

### Disclaimer
The information provided in this CME activity is for continuing education purposes only and is not meant to substitute for the independent medical judgment of a healthcare provider relative to diagnostic and treatment options of a specific patient's medical condition.

### Commercial Support
The following commercial interest has provided support for this live activity: Mallinckrodt Pharmaceuticals (Satellite Symposium).

# Program Schedule

## Friday, May 20, 2016

**7:00 am – 5:00 pm** Registration

**7:00 am – 8:00 am** Continental Breakfast with Exhibitors

**8:00 am – 8:30 am** Welcome Address and Introduction
Aryeh Shander, MD, FCCM, FCCP, President, SOCCA
Daryl J. Kor, MD, MSc, Chair,
Committee on Education

**8:30 am – 10:30 am** **Education Session I**
**The Anesthesiologist-Intensivist and the Current Era of Healthcare Reform**

**Moderator:** Daryl J. Kor, MD, MSc

- **The Anesthesia Quality Institute and ICU Metrics**
  Avery Tung, MD, FCCM, The University of Chicago, Chicago, Illinois
- **Bundled Payments-What Does This Mean for the Intensivist?**
  David L. Reich, MD, The Mount Sinai Hospital, New York, New York
- **Critical Care Organizations in Academic Medical Centers**
  Daniel R. Brown, MD, PhD, FCCM, Mayo Clinic, Rochester, Minnesota

**10:30 am – 11:00 am** Break with Exhibitors

**11:00 am – 12:00 pm** **Education Session II – Big Data in Critical Care**

**Moderator:** Adam S. Evans, MD, MBA

- **Big Data Defined: What Does It Really Mean for Quality Management in the ICU**
  Jesse M. Ehrenfeld, MD, MPH, Vanderbilt University Medical Center, Nashville, Tennessee
- **Challenges in the Use of Big Data in the ICU**
  James M. Blum, MD, Emory University School of Medicine, Atlanta, Georgia
- **MIMIC-2 Project**
  Daniel S. Talmor, MD, Beth Israel Deaconess Medical Center, Boston, Massachusetts

**12:00 pm – 12:30 pm** **SOCCA Lifetime Achievement Award Presentation**
**Ronald G. Pearl, MD, PhD,** Stanford University School of Medicine, Stanford, California

**12:30 pm – 1:30 pm** Lunch Syposium (non CME)

**1:45 pm – 3:00 pm** **Education Session III**
**Trials You Should Be Aware Of: An Update from the Critical Care Research Networks**

**Moderator:** Andrew C. Steel, BSc, MBBS

- US Critical Illness and Injury Trials Group (USCIITG)
  Raquel R. Bartz, MD, Duke University School of Medicine, Durham, North Carolina
- The PETAL Clinical Trials Network
  Shahzad Shaefi, MD, Beth Israel Deaconess Medical Center, Boston, Massachusetts
- Canadian Critical Care Trials Group
  Hannah Wunsch, MD, University of Toronto, Toronto, Ontario, Canada

**3:00 pm – 3:15 pm** **SOCCA Young Investigator Award Presentation**

**A Novel Association Between High Density Lipoprotein Levels and the Risk of Acute Kidney Injury After Cardiac Surgery**
Loren E. Smith, MD, PhD, Vanderbilt University Medical Center, Nashville, Tennessee

**3:15 pm – 4:00 pm** Moderated Poster Session

**4:00 pm – 4:15 pm** Break with Exhibitors

**4:15 pm – 5:15 pm** **Education Session IV – Update on Devices for the Failing Organ in the ICU**

**Moderator:** Andrew C. Steel, BSc, MBBS

- **Cardiac**
  Joseph S. Meltzer, MD, UCLA Medical Center, Los Angeles, California
- **Assist Devices to Support the Failing Lung**
  Peter von Homeyer, MD, University of Washington, Seattle, Washington
- **Liver Support and Liver Replacement: Ready for Prime Time?**
  Gebhard Wagener, MD, Columbia University, New York, New York

**5:15 pm – 5:30 pm** Closing Remarks

**5:30 pm – 6:15 pm** SOCCA Annual Business Meeting

**5:30 pm – 6:30 pm** Resident/Fellow Program

**6:15 pm – 7:30 pm** SOCCA Reception with Exhibitors

**Preliminary schedule as of press time*

# Session Learner Objectives

## 8:30 am – 10:30 am

## Education Session I

## The Anesthesiologist-Intensivist and the Current Era of Healthcare Reform

After participating in this activity, the learner will be able to:

- Review current knowledge with respect to the use and effectiveness of ICU quality metrics.
- Discuss challenges in the use of outcome-based quality metrics.
- Review AQI-proposed definitions and quality metrics applicable to the ICU.
- Describe the relative portions of bundled payments that are controllable with anesthesiologist/intensivist intervention.
- Create analyses of excess days and length of stay that affected healthcare delivery.
- Identify the elements of a respiratory care pathway that facilitates more rapid recovery.
- Describe types of structure and governance of critical care organizations in North America.
- Discuss factors that impact the transition from traditional Department- or Division-based models to a critical care organization.
- Explain benefits and risks of a critical care organization in an academic medical center.

## 11:00 am – 12:00 pm

## Education Session II

## Big Data in Critical Care

After participating in this activity, the learner will be able to:

- Define the concept of big data and related concepts of data curation, visualization, and querying.
- Identify current state of healthcare analytics.
- Articulate challenges and trends in big data analytics in healthcare.
- Discuss how healthcare analytics and big data can transform the clinical care and quality management.
- Identify practical applications and best practice of healthcare analytics.
- Review types of data available in the ICU.
- Describe barriers to accessing data for clinical purposes.
- Discuss methods for using big data for clinical research.
- Recall the research opportunities in the MIMIC III database.
- Assess the eICU Research Institute and identify available resources.

*(Continued on page 8)*

# Session Learner Objectives, Continued from Page 7

## 1:45 pm – 3:00 pm

## Education Session III

## Trials You Should Be Aware Of: An Update from the Critical Care Research Networks

After participating in this activity, the learner will be able to:

- Identify the U.S. Critical Illness and Injury Trials Group.
- Discuss the current studies being conducted under the USCIIT Group umbrella.
- Describe steps for involvement with the USCIIT Group.
- Review the PETAL network structure.
- Describe the current PETAL multicenter trials.
- Relate the scientific rational behind the current trials.
- Describe the history of the Canadian Critical Care Trials Group
- Relate the current structure and mandate of the Canadian Critical Care Trials Group.
- Discuss the large randomized controlled trials currently supported by the Canadian Critical Care Trials Group.

## 4:15 pm – 5:15 pm

## Education Session IV

## Update on Devices for the Failing Organ in the ICU

After participating in this activity, the learner will be able to:

- Identify mechanical devices to support the left heart.`
- Identify mechanical devices to support the right heart.
- Describe techniques for patient mobilization while on mechanical circulatory support.
- Describe differential indications for interventional lung assist.
- Discuss the function of the various assist devices.
- Discuss the outcomes of patients supported with those devices.
- Identify the side effects of those techniques.
- Define the pathophysiology of acute and acute-on chronic liver failure
- Recall the epidemiology of acute liver failure and the history of liver replacement devices.
- Recognize complexities of replacing specific functions of the liver.
- Discuss the theoretical advantages and clinical limitations of specific liver support systems such as:
  - Molecular Adsorbent Recirculating System, Single Pass Albumin
  - Dialysis and plasma filtration treatment systems
- Name conventional therapeutic interventions for acute liver failure.

# SOCCA Focus on Critical Care Day

## At the IARS 2016 Annual Meeting and International Science Symposium

## Saturday, May 21, 2016

The Society of Critical Care Anesthesiologists (SOCCA) Focus on Critical Care Day on Saturday, May 21 will examine and challenge current practices in critical care and highlight new discoveries in research and education. This SOCCA supported, dynamic education program will include two Review Course Lectures, three Panels, and one Problem-Based Learning Discussion Session, presented by the leaders in critical care anesthesiology. SOCCA full registrants may attend the bonus Focus on Critical Care Review Course Lectures and Panels as part of their SOCCA Annual Meeting registration fee (pre-registration is required). The PBLD requires an additional fee.

### Review Course Lectures

**1:00 am – 1:45 pm**

- **Bad, Bad Blood**

  Presenter: Stephen D. Surgenor, MD, MS, Professor of Anesthesiology, Geisel School of Medicine and of The Dartmouth Institute, Lebanon, New Hampshire

**2:00 pm – 2:45 pm**

- **What's New in Perioperative Resuscitation**

  Presenter: Vivek Moitra, MD, Associate Professor of Anesthesiology, Columbia University College of Physicians and Surgeons, New York, New York

### Probem-Based Learning Discussion

**12:00 pm – 1:00 pm**

**Please Mend My Broken Heart**

Moderator: Miko Enomoto, MD, Clinical Associate Professor, Critical Care Medicine, Program Director, Department of Anesthesiology and Perioperative Medicine, Oregon Health and Science University, Portland, Oregon

*The PBLD requires an additional fee and separate registration with the IARS.*

### Panels

**9:30 am – 11:00 am**

**Optimizing the Patient During the Perioperative Period**

**Moderator: Patricia Murphy, MD,** Associate Professor, Department of Anesthesiology, University of Toronto, Toronto, Ontario, Canada; International Representative, SOCCA

**Panelists:**

- **Renal Protective Strategies**

  Linda Liu, MD, Professor, Anesthesia and Perioperative Care, University of California, San Francisco, San Francisco, California; Director, SOCCA

- **Delirium/Cognitive Dysfunction in the Continuum of Care**

  Christopher G. Hughes, MD, Associate Professor of Anesthesiology; Program Director, Anesthesia Critical Care Medicine, Vanderbilt University Medical Center, Nashville, Tennessee

- **Heart Failure**

  Andrew Steel, MBBS, Assistant Professor, Department of Anesthesiology, University of Toronto, Toronto, Ontario, Canada

(Continued on Page 10)

**All SOCCA Focus-On Critical Care Sessions will take place on Saturday, May 21, at the Hilton San Francisco Union Square. Your SOCCA badge will admit you to these sessions.**

# SOCCA Focus on Critical Care Day

## At the IARS 2016 Annual Meeting and International Science Symposium

## Saturday, May 21, 2016

Panels, Continued from Page 9

**2:45 pm – 4:15 pm**

**Sepsis – Current Controversies**

**Moderator: Daniel R. Brown, MD, PhD, FCCM,** Professor of Anesthesiology, Mayo Clinic College of Medicine, Rochester, Minnesota; Treasurer and ASA Delegate, SOCCA

**Panelists:**

- **Choices for Volume Resuscitation**

  Peggy White, MD, Assistant Professor of Medicine, Associate Program, Director of the Multidisciplinary Adult Critical Care Medicine Fellowship, University of Florida College of Medicine, Gainesville, Florida

- **Monitoring Physiologic Parameters**

  Miguel A. Cobas, MD, FCCM, Associate Professor of Clinical Anesthesiology, Program Director, Critical Care Medicine Fellowship, University of Miami Health System, Miami, Florida; Secretary, SOCCA

- **Mechanical Ventilation Strategies**

  Steven G. Venticinque, MD, Professor of Clinical Anesthesiology & Surgery, Program Director, Anesthesiology Critical Care Medicine Fellowship, Department of Anesthesiology, University of Texas Health Science Center at San Antonio, San Antonio, Texas

**4:30 pm – 6:00 pm**

**Perioperative Medicine and Critical Care Anesthesiology**

**Moderator: Brenda G. Fahy, MD, MCCM**

**Panelists:**

- **Thinking Outside the Walls of the ICU**

  Brenda G. Fahy, MD, MCCM, Professor of Anesthesiology, Division Chief, Critical Care Medicine Anesthesiology, University of Florida College of Medicine, Gainesville, Florida; Immediate Past President, SOCCA

- **Care in the Continuum–Transitions of Care**

  Aryeh Shander, MD, FCCM, FCCP, Chief, Department of Anesthesiology, Critical Care Medicine, Pain Management and Hyperbaric Medicine, Englewood Hospital and Medical Center, Englewood, New Jersey; Clinical Professor of Anesthesiology, Medicine and Surgery, Icahn School of Medicine at Mount Sinai, New York, New York; President, SOCCA

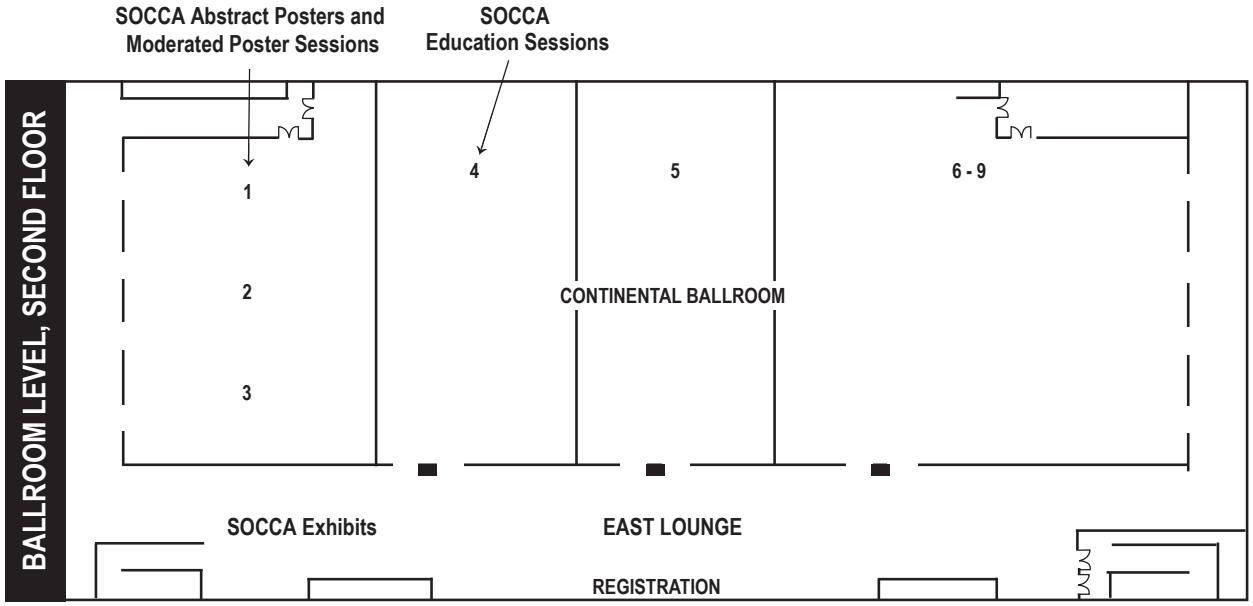
- **Added Value to the Health Care System**

  Ruben J. Azocar, MD, FCCM, Chairman, Anesthesiologist-in-Chief, Associate Professor, Department of Anesthesiology, Tufts University School of Medicine, Boston, Massachusetts

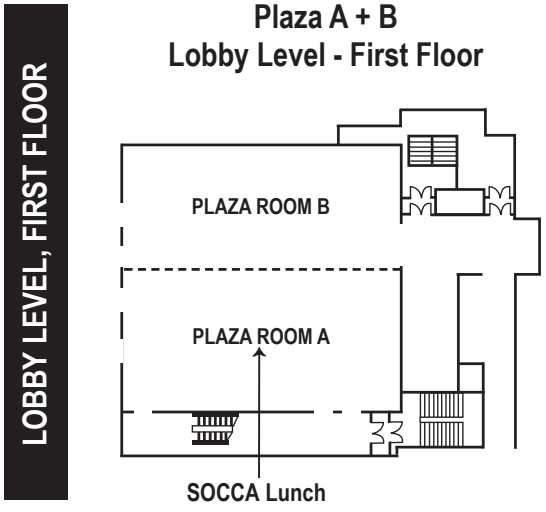
# Floor Plans

## Hilton San Francisco Union Square

### Continental Ballroom
### Ballroom Level - Second Floor




### Plaza A + B
### Lobby Level - First Floor



# SOCCA Poster Presentations

## SOCCA Poster Presentations, continued

## SOCCA Poster Presentations, continued

# PS01-01: AIRWAY MANAGEMENT & ANESTHETIC PHARMACOLOGY & CARDIOVASCULAR ANESTHESIOLOGY

Posters: 1 - 7

**Moderator: Rubin J. Azocar, MD, FCCM**

Poster 1

# A Novel Nasal PAP Mask Assembly Provided CPAP Pre-Oxygenation and Apneic Oxygenation in a Septic Patient With Respiratory Failure During RSI of General Anesthesia for Emergency ERCP

Achillina Rianto M.D.; Amanda Douchette M.D.; Temi Ajibade CRNA; Scott Mellender M.D.; John Denny M.D.; James Tse M.D.

Rutgers, Robert Wood Johnson Medical School

**Introduction**: Septic patients with respiratory failure always present challenges for anesthesia providers during induction of general anesthesia (GA). A novel nasal PAP mask assembly has been shown to maintain oxygenation by providing CPAP, BiPAP and assisted ventilation in obese patients with OSA or difficult airway during sedation or GA induction.1-5 We used this technique to provide continuous oxygenation in a septic patient during RSI of GA.

**Case Description:** A 47 y/o female with HTN, myasthenia gravis, hepatitis C, T cell lymphoma complicated by chemotherapy-induced pancytopenia and septic shock presented for emergency ERCP. Patient had RUQ pain and elevated liver enzymes and bilirubin. Abdominal ultrasound revealed small gallstones and gallbladder wall thickening. Her bilirubin level was rising despite a percutaneous cholecystostomy was performed. For the 4 days prior to procedure patient developed progressive shortness of breath and hypoxia. CXR revealed progressed bilateral opacities which could represent pulmonary edema or pneumonia. Upon arrived in the holding area, the patient was sitting up in a stretcher and was tachypneic (24-30/min) and tachycardiac (HR 132/min) with BP 117/77 on phenylephrine infusion. Her SpO2 was 88% on 6L O2/min via nasal cannula, Her SpO2 improved to 97% with a non-rebreathing mask (10 L O2/min). She was transported to the OR in upright position. An infant mask with a fully inflated air cushion was secured over her nose with head straps and connected to a breathing circuit and the anesthesia machine. The APL valve was adjusted to deliver 5-6 cm H2O CPAP with 8 L O2/min. After her SpO2 improved to 100%, RSI of GA was induced with 10 mg etomidate and 100 mg succinylcholine. Her back was lowered to a beach chair position (30 degree). Patient desaturated to 67% SpO2 within 30 seconds of GA induction. Intubation was accomplished quickly with a video-laryngoscope and with the nasal CPAP mask assembly providing apneic oxygenation (Photo). Her SpO2 quickly returned to 100% with positive pressure ventilation and PEEP. Her BP was maintained with phenylephrine infusion and vasopressin boluses. Her HR reduced to low 100'S. She tolerated ERCP with sphincterotomy well with 99-100% SpO2 throughout the procedure and was transferred to MICU intubated. The next day, she was awake and alert while on respiratory support and her hemodynamics were stable. Conclusion: This nasal PAP mask assembly provided continuous oxygenation by delivering nasal CPAP pre-oxygenation and apneic oxygenation during RSI of GA in a septic patient. It avoided severe hypoxemia in a patient with very low respiratory reserve and may improve patient safety.

**References:**


1. www.tsemask.com
2. SAMBA 28th AM, April 2013
3. SAM AM, Sept 2014
4. 68th PGA (MCC7136), Dec 2014
5. Euroanaesthesia (#12AP7-6), May 2015


Poster 2

# A Novel Nasal PAP Mask Assembly Used as a Rescue Device to Maintain Spontaneous Ventilation and Oxygenation In An Elderly Heparinized Patient With Airway Obstruction Under MAC for Cystoscopy and Ureteral Stent Insertion

Achillina Rianto M.D.; David Hao B.A.; Sylviana Barsoum M.D.; James Tse M.D.

Rutgers, Robert Wood Johnson Medical School

**Introduction**: Patients under monitored anesthesia care (MAC) often receive IV sedation and O2 via a nasal cannula (NC). Over-sedation and/or airway obstruction may cause severe desaturation, especially in obese patients with obstructive sleep apnea (OSA). To avoid constant airway manipulation or the risk of epistaxis caused by inserting a nasal trumpet, a novel nasal CPAP mask assembly has been used to maintain spontaneous ventilation and improve oxygenation in deeply-sedated obese OSA patients (Photo).1-5 We report its use in an elderly heparinized patient with airway obstruction under MAC for cystoscopy.

**Case Description:** A 79 y/o female (5'5", 75 kg, BMI 28 kg/m2) with right ureteral compression and severe hydronephrosis secondary to a large abdominopelvic mass (possible ovarian carcinoma) presented for urgent cystoscopy with ureteral stent insertion. The patient had right lower extremity DVT and was currently on heparin infusion. She complained of dyspnea on exertion but denied any cardiopulmonary diseases or OSA. Her room air O2 saturation (Sat) was 95%. After pre-oxygenation with NC O2 (4 L/min) and a face tent, her O2 Sat increased to 100%.1 She received lidocaine (40mg) with small propofol boluses (a total of 120 mg) andpropofol infusion at100 mcg/kg/min. A few minutes later, her airway was obstructed as indicated by the disappearance of EtCO2 and her O2 Sat decreased to 96%. Propofol infusion was decreased to 50 mcg/kg/min. An infant mask with a fully-inflated air cushion was quickly secured on her nose with head straps. It was connected to the anesthesia machine via a breathing circuit (Photo). The APL valve was adjusted to deliver CPAP (3 cm H2O) and O2 3 L/min and fresh air 1 L/min. She resumed spontaneous ventilation and her O2 Sat increased to 100%. Her airway was obstructed again with reducing CPAP to zero. She resumed spontaneous ventilation as soon as CPAP (3 cm H2O) was re-established. The patient tolerated the procedure well and maintained 100% O2 Sat for the rest of the procedure. She recovered from sedation quickly prior to moving over to the stretcher and was elated that endotracheal intubation was avoided.

**Discussion:** This nasal CPAP mask assembly was used as a rescue device in a deeply-sedated heparinized patient with airway obstruction during urgent cystoscopy with ureteral stent insertion. It maintained spontaneous ventilation and oxygenation in an elderly patient without history of OSA. It may improve patient safety at a low cost.

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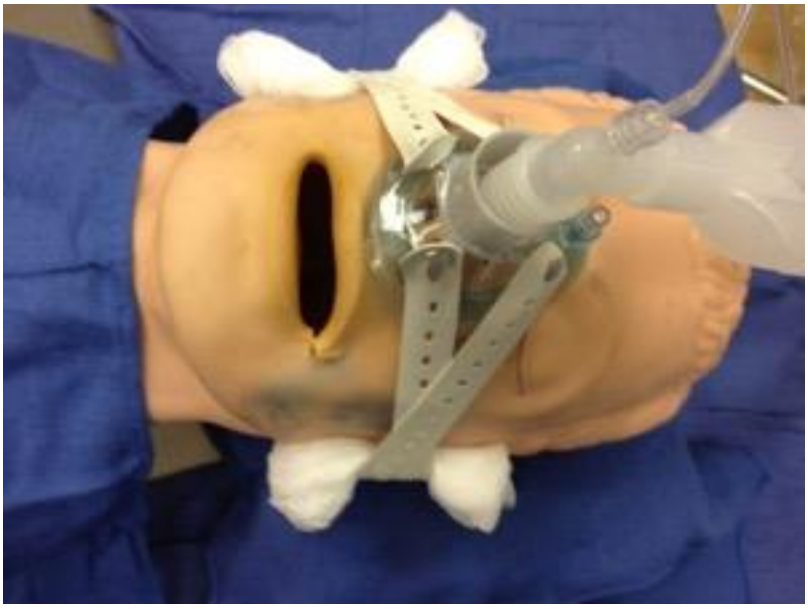

Poster 3

# Uvular Hematoma After Intubation Under Videolaryngoscopy: Techniques to Decrease Risk of Airway Injury

Wayne Wang M.D.; James Tse M.D.; John Denny M.D.

Rutgers, Robert Wood Johnson Medical School

**Introduction:** Difficulty with airway management remains an important issue in anesthesia despite the armamentarium of airway devices such as the laryngeal mask airway, fiberoptic bronchoscope, and videolaryngoscope (VL). The VL has advanced our ability to manage more challenging airways, however, improper use may result in airway injury. We describe a possible complication with the VL and suggest techniques to decrease the risk of injury.

**Case Report:** A 68 y/o male with HTN, DM, HLD and BMI 27 kg/m2 presented for a scheduled pipeline embolization of a left vertebral artery aneurysm. The patient was on dual anti-platelet therapy, but a pre-operative platelet reactivity test showed a low level of platelet inhibition. Neurosurgery requested for the patient to receive aspirin 325 mg and clopidogrel 75 mg, so a rapid sequence intubation was done with lidocaine 80 mg, propofol 200 mg, succinylcholine 100 mg, and fentanyl 100 mcg. A VL was used due to his Mallampati Class 3 airway and large neck circumference, and revealed an anterior airway with a Cormack-Lehane Grade 2 view. There was mild difficulty passing a 7.0 endotracheal tube (ETT), but no injury was noted. Heparin 4000 units was later given prior to deployment of the device. The procedure was uncomplicated, and the patient was extubated and brought to the PACU where a heparin drip was started. However, a mass was later noted in his oropharynx that could not be suctioned and caused him to gag, although he maintained 100% O2 saturation without any airway obstruction. The heparin drip was held, and ENT evaluated the patient, diagnosing a uvular hematoma. The patient was treated with dexamethasone 8 mg IV and oral analgesic spray, and was monitored in the SICU as was customary after the procedure. The rest of the patient's stay was otherwise uneventful. A swallow evaluation showed no signs of dysphagia, and he was transferred to the floor without delay and discharged to home with reported resolution of the hematoma in 3 weeks**.**

**Conclusion**: Difficult intubation with the VL generally occurs as a result of the blade making it harder to manipulate and direct the ETT past the vocal cords.1-2 A potential blind spot also exists if the VL user focuses too intently on the screen before the ETT comes into view. This blind spot may be overlooked and at increased risk of injury, highlighting the importance of direct visualization as the ETT enters the mouth.3-4 In this case, the uvular hematoma may have developed due to inadvertent injury while using the VL. Other possible contributory factors are dual-antiplatelet therapy5 and oral suctioning in a heparinized patient.6 This helpful 4-step technique can be used to decrease the risk of injury. Step 1: Look in the mouth, insert the VL and advance towards the root of the tongue. Step 2: Look at the screen, position the VL for optimal view. Step 3: Look in the mouth, insert the ETT and advance towards the tip of the VL. Step 4: Look at the screen, direct the ETT through the vocal cords.

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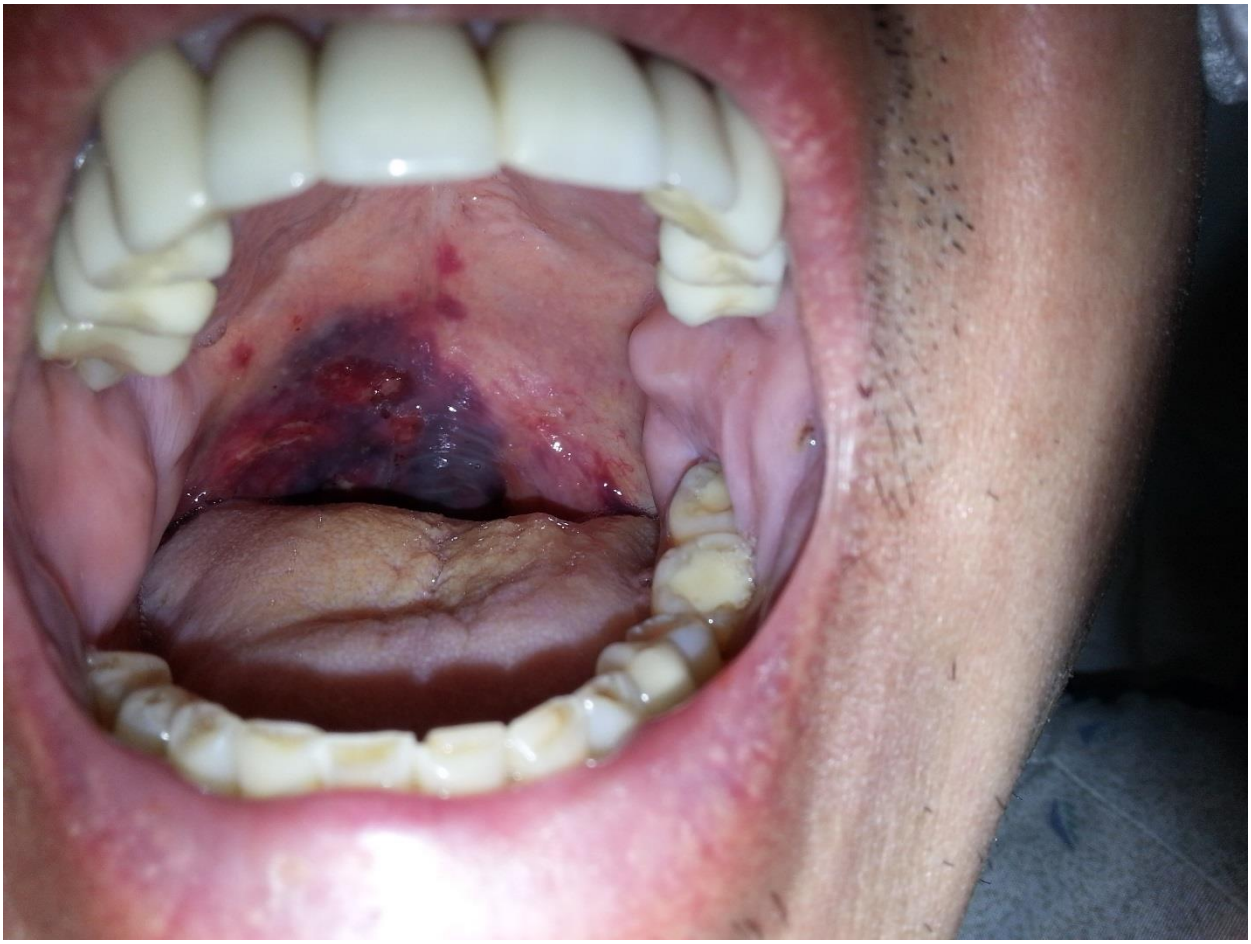

Poster 4

# Predictors of Failed Extubation in the Early and Late Period

Thuan M Ho M.D.; Michael Beitzel B.S.; Tan N Trinh M.D.; Aristides Koutrouvelis M.D.; William E Whitehead M.D.; Michael P Kinsky M.D.

University of Texas, Medical Branch

**Introduction:** Extubation failure is associated with a number of negative outcomes including pneumonia, prolonged mechanical ventilation and increased mortality (30-50%)(1,2). Despite various extubation criteria and spontaneous breathing trials, the failed extubation rate ranges from 10-19%(3,4). There is a critical need to precisely identify predictors of extubation success and failures. It's apparent that co-morbidities such as End Stage Renal Disease (ESRD), CAD and CHF increase the likelihood of extubation failure (5). Few studies have looked into the effect of co-morbidities on early versus late extubation failure (6,7). Specifically, whether co-morbidities such as CAD, CHF, ESRD, Pulmonary HTN, use of vasopressors impact when patients fail extubation [early vs late] remain to be defined.

**Hypothesis**: We hypothesize that congestive heart failure and CAD will be associated with early failure (within 48hrs) due to cardiopulmonary load changes that occur from positive pressure ventilation to spontaneous ventilation.

**Method**: A retrospective study was conducted of intubated patients in the Surgical Intensive Care Unit at our institution from January 2012 to December 2014. Only patients intubated for 3 or more days and extubated were included. Patient who had tracheostomy, withdrawal of care of died before extubation were excluded. The remaining patients were grouped into those who were extubation successfully, and those who require re-intubation within 7 days. Patients who fail were grouped into early (< 48 hr) and late (>48hr).

Data endpoints collected include co-morbidities such as CAD, CHF, MI, Stroke, CRI/ARF/ESRD, liver failure, sepsis, COPD, pneumonia, asthma and metabolic disease.

**Results**: 400 charts were reviewed but only 223 met inclusion criteria, which included 170 (76%) that were successfully extubated and 53 (24%) required re-intubation within 7 days. Of the 53 patients that required re-intubation, 34/53 (64%) failed early and 19/53 (36%) failed late (figure 1). 21% of the late group had EF <30% compare to 3% in the Early group (P 0.015). The late group have higher P:F [300 vs 251 (P 0.063)] and lower survival rate [37% vs 71% (P 0.008)]. Increased age and mortality was associated with late re-intubation. History of CVA and CHF were more common in patients re-intubated in the later group.

**Discussion**: Those in the late group failed likely secondary to cardiovascular disease and heart failure. The higher percentage of the patients with EF of less than 30% was not what we predicted in our hypothesis, suggesting that increased afterload and preload can be compensated for several days. Our data suggests that increased vigilance in patients with cardiovascular disease should continue beyond 72 hr post extubation. Early vs late extubation failures may have discrete etiologies, awareness of which may reduce the incidence of complications.

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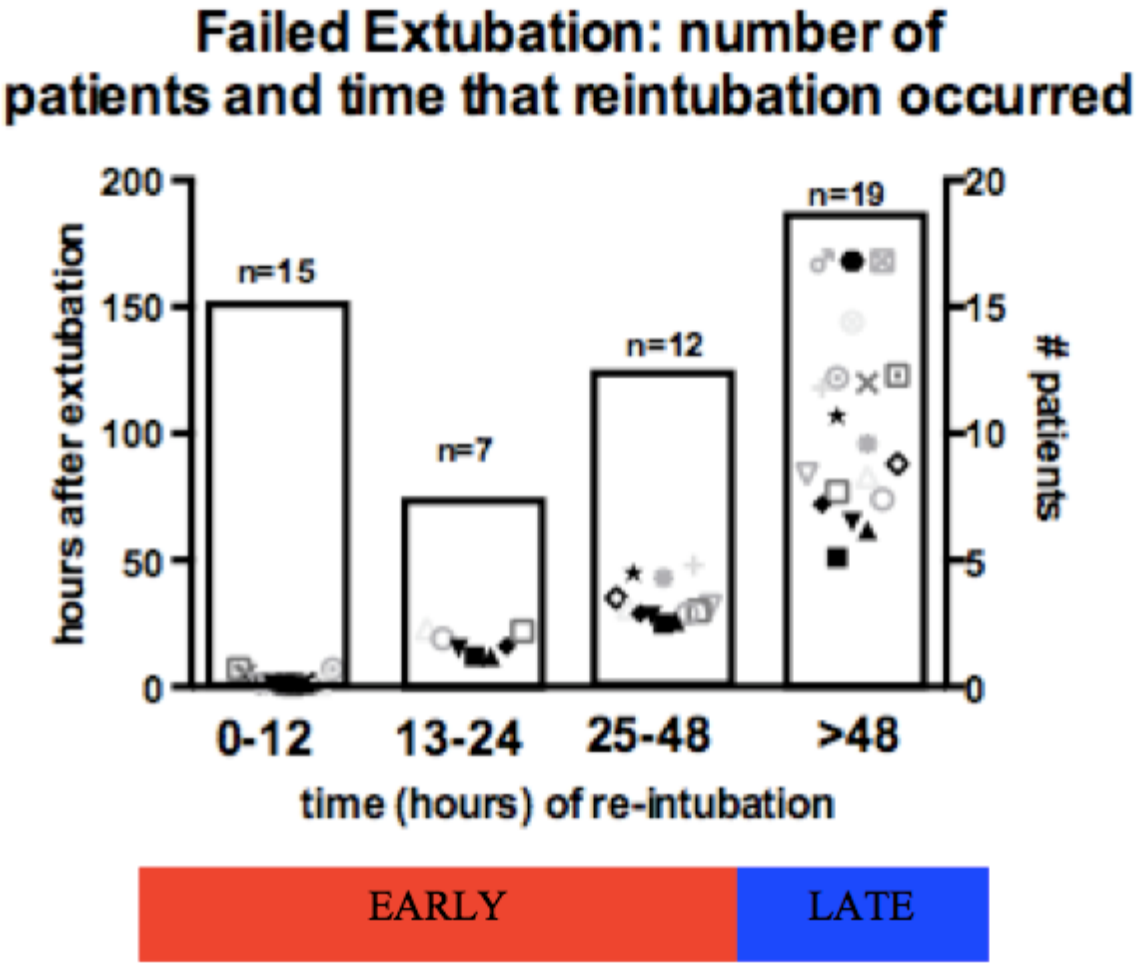

Poster 5

# A Case Report of Canagliflozin Induced Diabetic Ketoacidosis in the Perioperative Period

Tariq Hanifi M.D.; Jonathan Van Ornam M.D.[2], M.B.A.; Krystina L Geiger PharmD., B.C.B.S[1]; Nicholas Sadovnikoff M.D.[1]; Stephen Estime M.D.[1]

Brigham and Women's Hospital[1]; Harvard Medical School[2]

**Introduction:** Metabolic derangements are common in diabetics postoperatively and may be triggered by several factors including stress response/SIRS, variability in nutritional intake and side-effects encountered with diabetic medications such as hypoglycemia, lactic acidosis and diabetic ketoacidosis (DKA). In this case scenario we describe a patient with non-insulin dependent diabetes who, after undergoing elective surgery, developed euglycemic ketoacidosis in the setting of canagliflozin usage.

**Case Report:** The patient was a 62 year-old male with a medical history of non-insulin-dependent diabetes on metformin and dulaglutide and newly diagnosed invasive oropharyngeal squamous cell carcinoma. The patient was status post elective robotic transoral tonsillectomy and neck dissection and was admitted to the intensive care unit (I.C.U) post operatively for airway monitoring. In the I.C.U the patient developed persistent thirst and polyuria. Laboratory evaluation showed moderate anion gap metabolic acidosis and mild acute kidney injury without electrolyte abnormalities. After intravenous crystalloid hydration a repeat set of laboratory results showed worsening anion gap metabolic acidosis, elevated creatinine, euglycemia, glycosuria and a normal lactate. Serum and urinary ketones were elevated and an arterial blood gas showed metabolic acidosis with respiratory compensation. The patient remained hemodynamically and neurologically stable. Although atypical, the laboratory findings and clinical presentation were consistent with diabetic ketoacidosis. The patient was treated with continuous intravenous insulin along with intravenous fluids with dextrose. Within 72 hours of diagnosis of DKA, the patient's DKA had resolved and the patient was discharged from the hospital on a subcutaneous insulin regiment.

**Conclusion**: Although the patient did not have insulin-dependent diabetes, he was taking multiple diabetic agents including canagliflozin, a novel diabetic medication that was linked to at least 20 cases of diabetic ketoacidosis from March 2013 to June 2014 in mostly non-insulin dependent diabetic patients. Canagliflozin acts as a sodium glucose transporter 2 (SGLT-2) inhibitor in renal tubular cells, blocking glucose re-absorption and causing glycosuria. The hallmark of ketoacidosis in these cases is euglycemia. In this case the etiology of DKA was multifactorial. Canagliflozin-induced glycosuria and a decrease in carbohydrate availability was likely the cause. This was compounded by the acute stress of surgery and the discontinuation of metformin and dulaglutide.

We report this case to alert anesthesiologists and other perioperative providers to the potential for the development of DKA in patients taking canagliflozin. Canagliflozin has been shown to produce delayed reversibility of SGLT-2 transport inhibition up to 11 days after cessation of usage of this medication. Its half life at maximally recommended doses is 10.6-13.1 hours. As the duration of action of this drug is

highly variable, we suggest that this agent should be discontinued at least three days prior to elective surgery and that the patient should be monitored closely postoperatively for signs or symptoms of DKA.

Poster 6

# Lactate Concentrations After Cardiac Surgery as a Predictor of Survival

Lauren D Rosenberg M.D.; Anna Mechling B.S.; Taryn Lai B.S.; Nina T Yoh; Mark JS Heath M.D.; Gebhard Wagener M.D.

Columbia University Medical Center, New York Presbyterian Hospital

**Introduction:** Lactate elevations are frequently due to hypoperfusion and are therefore considered an ominous sign in critical care medicine (1). Elevated lactate after cardiac surgery may be a sign of worsening cardiogenic or vasoplegic shock that require rapid intervention. Although increased lactate levels are often correlated with poor outcomes (2), the relationship between lactate levels and mortality after cardiac surgery has not yet been described.

**Methods**: This is a retrospective study of all cardiac surgery patients at one institution in 2011. Lactate levels were determined by the hospital laboratory based on clinical necessity. Short term (90-day) and 1-year mortality was determined using the US Social Security index. Receiver-operator characteristic (ROC) curves were used to determine the ability of peak lactate concentrations to predict mortality.

**Results**: This study included 1539 patients. 70 patients died within 90 days (4.5%) and 136 within one year (8.8%). Lactate concentrations were significantly higher at any time-point within the first week after surgery in 90-day and 1-year non-survivors. Peak lactate was 5.90 +/- 4.49 mg/dL versus 2.88 +/- 1.79 mg/dL ($p<0.001$, 90-day) and 4.64 +/- 3.71 mg/dl versus 2.86 +/- 1.78 mg/dL ($p<0.001$, 1-year) comparing non-survivors and survivors.
The area under the curve of lactate to predict mortality was 0.768 for 90-day and 0.635 for 1-year mortality. Only 8 of 19 patients (42.1%) with peak lactate concentrations above 10 mg/dL survived 1 year ($p<0.0001$). Kaplan-Meier Survival curves are depicted in figure 2.

**Discussion**: Peak lactate concentrations after cardiac surgery are good predictors of short-term but not long-term mortality. It may be useful to integrate lactate concentrations into models that are used to predict survival after cardiac surgery.

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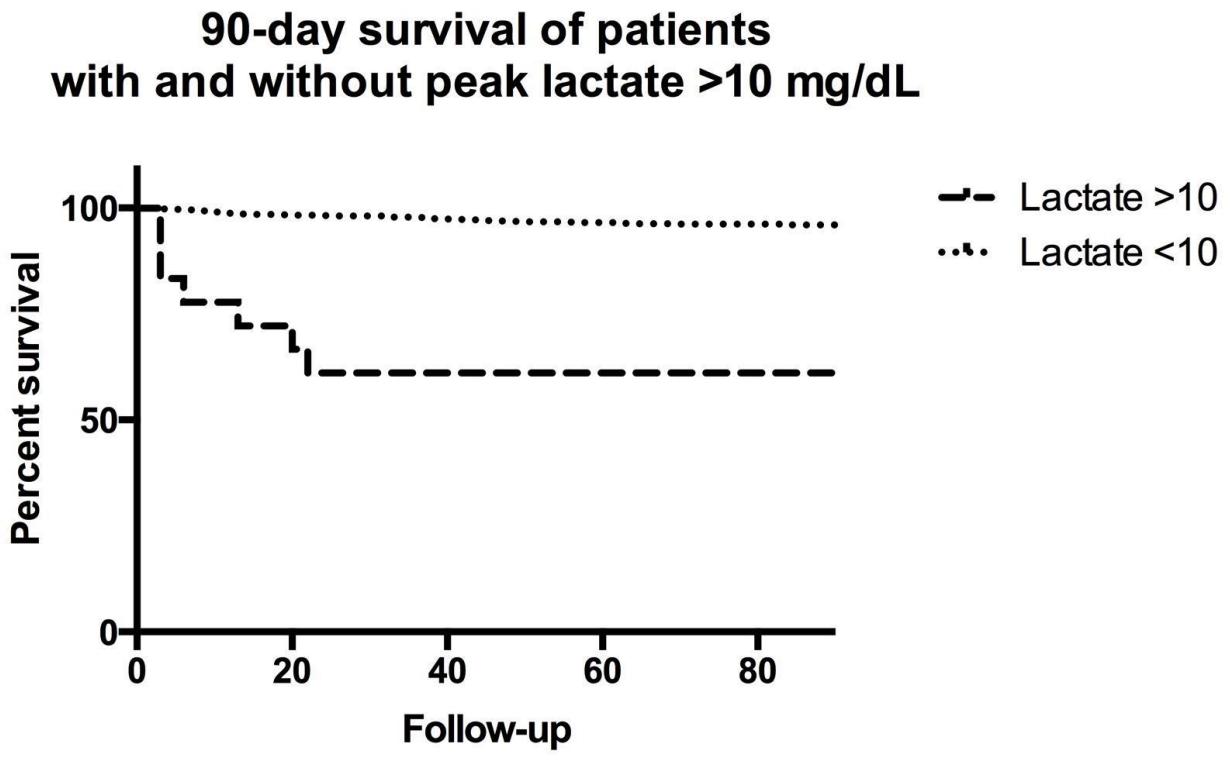
90-day survival of patients
with and without peak lactate >10 mg/dL
Percent survival
100
50
0
0
20
40
60
80
Follow-up
Lactate >10
Lactate <10

Poster 7

# Impact of Intraoperative Right Ventricle Dysfunction on Acute Kidney Injury and Delirium Following Cardiac Surgery

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Vanderbilt University

Right ventricle (RV) dysfunction is common in patients undergoing cardiac surgery and, via reduced cardiac output and venous congestion, reduces perfusion to the kidneys and brain. Acute kidney injury (AKI) and delirium affect a large number of patients following cardiac surgery (30%1 and 26%2 respectively). We tested the hypothesis that RV dysfunction is associated with AKI or delirium following cardiac surgery.

We performed a post hoc analysis of a prospectively collected 615-patient cardiac surgery cohort. RV dysfunction was assessed using transesophageal echocardiography (TEE) by board certified TEE anesthesiologists, after induction of anesthesia (baseline) and after separation from cardiopulmonary bypass (CPB) or completion of off-pump bypass grafting (postoperative). RV dysfunction was defined as mild, moderate, or severe hypokinesis and AKI using AKIN criteria (0.3 mg/dl creatinine rise within 48h of surgery). Delirium was assessed by research personnel using the CAM-ICU exam twice daily during ICU hospitalization. We measured associations between RV dysfunction and brain and kidney injury, adjusted for confounders between these associations and risk factors for the outcomes. Covariates included age, Charlson index, congestive heart failure, LVEF, baseline eGFR (AKI models only), mini-mental state exam score (delirium models only), valve surgery, and duration of CPB.

Sixty-one of 615 participants (9.92%) had right ventricle dysfunction at baseline (7.48%, mild; 2.14%, moderate; 0.3%, severe) and sixty-one (9.92%) following surgery (7.64%,mild; 1.79%, moderate; 0.49%, severe). 28 participants (4.6%) had RV dysfunction both at baseline and postoperative. One hundred twenty-four of 615 patients (20.1%) developed AKI following surgery and 144 (23.4%) delirium. Baseline RV dysfunction was associated with a 100% increase in the odds of AKI (OR, 2.00 [95% CI 1.01-3.97]; $P<0.05$), but postoperative RV dysfunction was not associated with AKI (Table). On the contrary, baseline RV dysfunction was not associated with delirium but postoperative RV dysfunction correlated with a 109% increase in the odds of delirium (OR, 2.09 (1.04-4.22]; $P=0.04$).

Baseline but not postoperative RV dysfunction was associated with the development of AKI and postoperative but not baseline RV dysfunction was associated with development of delirium. While further studies are needed, preoperative assessment of RV dysfunction may improve AKI risk stratification and treatments to reduce postoperative RV dysfunction should be tested to reduce delirium following cardiac surgery.

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**Table**. Associations between baseline or postoperative right ventricular dysfunction and AKI (defined using AKIN criteria) or delirium (diagnosed by CAM-ICU) following cardiac surgery

| Outcome | TEE exam | Covariate | Odds Ratio | 95% CI | P value |
|---|---|---|---|---|---|
| **AKI** | **Baseline** | **RV Dysfunction** | **2.00** | **1.01 - 3.97** | **0.05** |
| | | Age, years | 1.02 | 0.99 - 1.04 | 0.14 |
| | | Charlson index, 1-24 | 1.35 | 1.15 - 1.63 | 0.002 |
| | | Congestive heart failure | 1.29 | 0.68 - 2.44 | 0.43 |
| | | Left ventricle ejection fraction, % | 1.01 | 0.98 - 1.04 | 0.39 |
| | | Preop eGFR, mL/min/1.73m$^2$ | 0.99 | 0.98 - 1.01 | 0.62 |
| | | Valve surgery | 0.25 | 0.11 - 0.57 | 0.001 |
| | | Cardiopulmonary bypass time, minutes | 4.70 | 1.79 - 12.35 | 0.002 |
| | Postoperative | RV Dysfunction | 1.46 | 0.72 - 2.98 | 0.29 |
| | | Age, years | 1.03 | 0.99 - 1.05 | 0.06 |
| | | Charlson index, 1-24 | 1.32 | 1.09 - 1.61 | 0.005 |
| | | Congestive heart failure- | 1.69 | 0.86 - 3.29 | 0.13 |
| | | Left ventricle ejection fraction, % | 1.01 | 0.98 - 1.04 | 0.52 |
| | | Preop eGFR, mL/min/1.73m$^2$ | 1.00 | 0.99 - 1.02 | 0.93 |
| | | Valve surgery | 0.21 | 0.09 - 0.51 | 0.001 |
| | | Cardiopulmonary bypass time, minutes | 4.40 | 1.61 - 12.06 | 0.004 |
| **Delirium** | Baseline | RV dysfunction | 1.27 | 0.61 - 2.64 | 0.53 |
| | | Age, years | 1.03 | 1.01 - 1.06 | 0.008 |
| | | Charlson index, 1-24 | 1.05 | 0.89 - 1.23 | 0.59 |
| | | Congestive heart failure- | 0.79 | 0.41 - 1.50 | 0.47 |
| | | Left ventricle ejection fraction, % | 0.99 | 0.96 - 1.01 | 0.38 |
| | | Mini-mental score, 1-30 | 0.84 | 0.73 - 0.96 | 0.009 |
| | | Valve surgery | 0.80 | 0.32 - 2.01 | 0.64 |
| | | Cardiopulmonary bypass time, minutes | 2.50 | 0.83 - 7.47 | 0.10 |
| | **Postoperative** | **RV dysfunction** | **2.09** | **1.04 - 4.22** | **0.04** |
| | | Age, years | 1.04 | 1.01 - 1.07 | 0.004 |
| | | Charlson Index, 1-24 | 1.02 | 0.85 - 1.21 | 0.85 |
| | | Congestive heart failure | 0.85 | 0.43 - 1.72 | 0.66 |
| | | Left ventricle ejection fraction, % | 0.99 | 0.96 - 1.01 | 0.33 |
| | | Mini-mental score, 1-30 | 0.83 | 0.72 - 0.96 | 0.01 |
| | | Valve surgery | 0.82 | 0.30 - 2.22 | 0.70 |
| | | Cardiopulmonary bypass time, minutes | 2.49 | 0.73 - 8.54 | 0.15 |

# PS01-02: CRITICAL CARE 1

## Posters: 8*, 9 - 11, 12*, 13

*Poster Withdrawn

**Moderator: Miguel Cobas, MD, FCCM**

Poster 9

# A Prospective Observational Pilot Study of ICU Sedation Variation Using Bispectral Index to Identify Diurnal Patterns Related to Change of Nursing Shifts

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University of Miami[1]; Jackson Memorial Hospital[2]

**Introduction**: The appropriate use and dosing of IV sedatives in mechanically ventilated intensive care unit (ICU) patients is key in preventing adverse effects(1) including prolonged mechanical ventilation(2) and delirium.(3) Intensivists often have the notion that patients may be oversedated in the nighttime hours despite protocol-based techniques. Although multiple sedation assessment scales are for sedation regimens, subjective differences have been found in the assessment of sedation levels between day and night caregivers, with night caregivers being less likely to judge patients as oversedated.(4) Bispectral index (BIS) for monitoring sedation in the ICU has been correlated with multiple clinical sedation scales(5,6) and can be useful for objective monitoring during deeper levels of sedation.(7) The objective of this study is to determine if shift time is associated with level of sedation. We hypothesized that patients during night shifts are maintained at deeper levels of sedation.

**Methods**: We prospectively enrolled 34 trauma and acute care surgery ICU patients that were mechanically ventilated and sedated with continuous IV infusion of either propofol or midazolam along with fentanyl infusions for analgesia. The patients had BIS monitors placed and data collected for a period of 24 hours. BIS data was recorded every minute while the signal quality index (SQI) was above 80 indicating a good signal for each patient. The BIS values for each patient for day (0700-1900) and night (1900-0700) shift were separated and averaged (Fig1). Paired T-tests were performed to detect differences between day shift and night shift BIS values.

**Results**: The BIS values were averaged for each shift per patient demonstrating no significant difference between mean day and night shift BIS values (52±13.2 vs 50.6±14.6, p=0.27).

**Conclusions**: Despite sentiment amongst critical care physicians that patients are oversedated during night shift as compared to the day, BIS values were no different between shifts. The data did demonstrate that patients were oversedated throughout the observation period as BIS values averaged 52 and 50.6, while values between 45 to 60 are consistent with general anesthesia. This data is consistent with findings that there is also loss of synchronized sleep-wake cycles in sedated ICU patients (8) as there was no diurnal BIS variation which is seen in physiologic sleep. (9,10) These findings suggest that although patients are oversedated in our ICU, no differences in sedation practices is evident based on objective BIS data between day and night shift.

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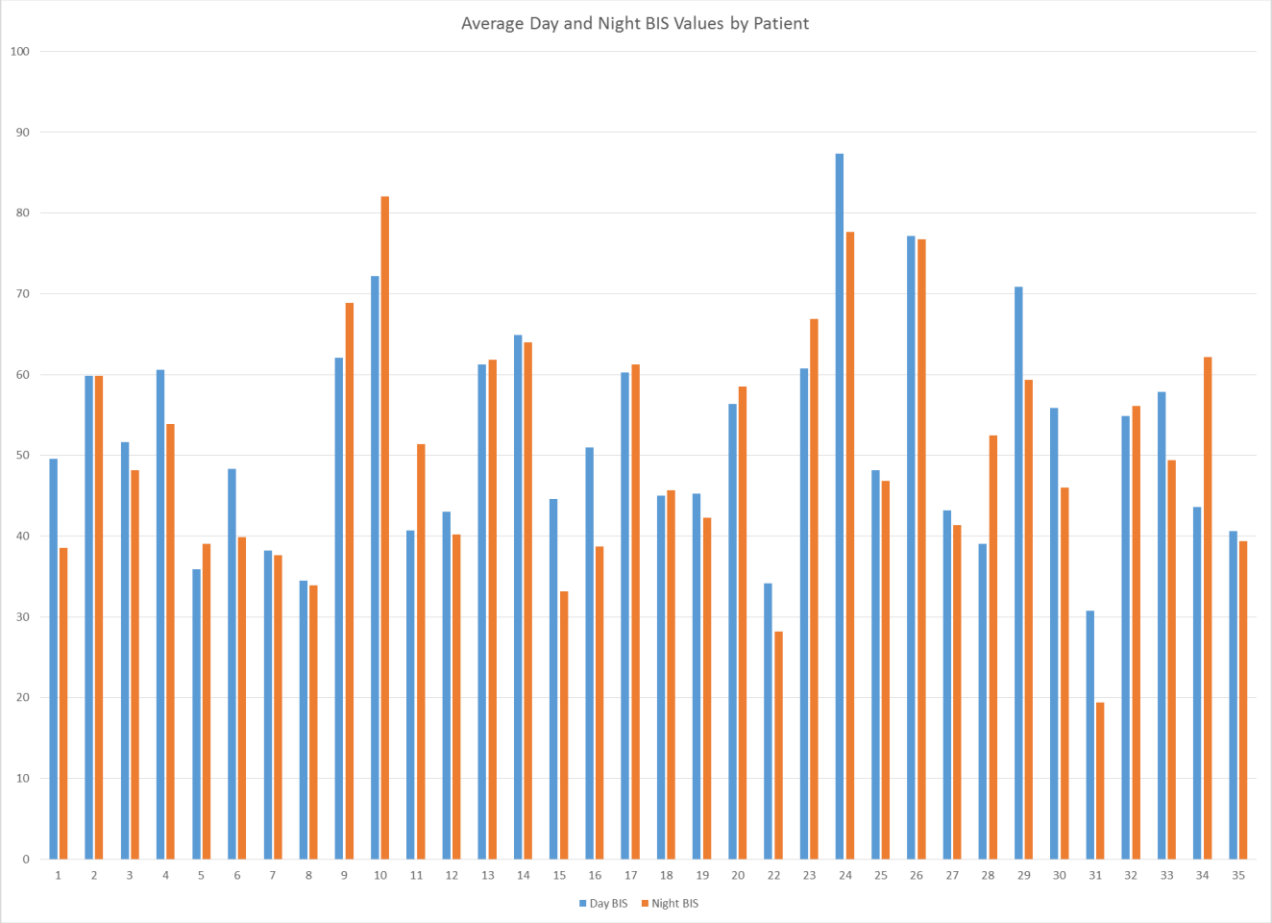

Poster 10

# Veno-Arterial Venous ECMO For Postoperative Cardiogenic Shock and ARDS After Liver Transplantation

Peter S Downey M.D.; Julia B Sobol M.D.

Columbia University; New York-Presbyterian Hospital

**Introduction**: Extracorporeal membrane oxygenation (ECMO) is an invaluable salvage device for cardiogenic shock now being used more frequently in severe acute respiratory distress syndrome (ARDS). Peri-operative cardiogenic shock and ARDS in liver transplantation are rare but associated with high mortality.1-5 Combined cardiopulmonary failure after liver transplant refractory to medical management has not been described. ECMO to achieve optimal oxygenation and adequate cardiac support could provide the best opportunity for patient survival.

**Case Description**: A 59-year-old woman was admitted to the surgical intensive care unit (SICU) following orthotopic liver transplantation for hepatocellular carcinoma (HCC). She had preoperative model for end-stage liver disease (MELD) score of 22. Due to adhesions, the diaphragm and pericardium were torn during dissection of the native liver. The orthotopic liver was also large-for-size. Within six hours of her admission to the ICU, she developed oliguria, severe hypotension, liver dysfunction, and intra-abdominal hypertension. She was emergently taken to the operating room for exploratory laparotomy. Upon decompression of the abdomen, she experienced a significant improvement in her hemodynamic parameters and peak airway pressures. The liver was congested with patent vessels, so a large Gore-Tex® patch was placed for planned staged abdominal closure. Within a few hours of her return to the ICU, she rapidly progressed to profound cardiogenic shock; an echocardiogram showed a moderate pericardial effusion. She underwent emergent bedside pericardial window with dramatic improvement in hemodynamics.

Over the following 24 hours, her cardiopulmonary function continued to decline, requiring the addition of epinephrine and inhaled nitric oxide for severe ARDS. The decision was made to proceed to peripherally cannulated ECMO. Cardiac surgery was called and VAV-ECMO was initiated via drainage from the right femoral vein and return via the left internal jugular vein and the left femoral artery. She experienced excellent hemodynamic response and rapid improvement in oxygenation. She was successfully bridged to re-transplantation on postoperative day (POD) 2. Cardiopulmonary function then improved significantly. The arterial limb of the ECMO circuit was removed on POD 4, and ECMO was decannulated on POD 6.

**Discussion**: Postoperative cardiogenic shock and ARDS can be devastating complications of liver transplantation. The combination of these processes is often fatal. Peripheral VAV-ECMO offers the unique capability of full cardiopulmonary support. Cannulation can be performed safely at the bedside and rapidly restore oxygenation and end-organ perfusion. VAV-ECMO can be lifesaving and should be considered in patients who develop refractory hemodynamic and respiratory complications after this surgery.

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Poster 11

# Association Between Plasma UCHL1 and BDNF Levels and Duration of Delirium in the Critically Ill

Christina J Hayhurst M.D.[1]; Timothy D Girard M.D., M.S.C.I.[1]; Jennifer L Thompson M.P.H.[2]; Rameela Chandrasekhar Ph.D.[1]; E. Wesley Ely M.D., M.P.H.[1]; Christopher G Hughes M.D.[1]

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**Introduction**: Delirium is an acute form of brain dysfunction that is prevalent in ICU patients, occurring in up to 80% of mechanically ventilated patients.(1) It has significant short and long-term effects on morbidity and mortality but an incompletely understood pathogenesis.(1) One hypothesis is that critical illness such as sepsis leads to neuroinflammation, resulting in direct neuronal injury and altered neurotransmission.(2) Two plasma biomarkers associated with neuronal injury and repair include ubiquitin carboxyl-terminal esterase-L1 (UCHL1) and brain-derived neurotrophic factor (BDNF), but their associations with delirium in the critically ill are unknown. UCHL1 removes oxidized or misfolded proteins in the brain, potentially preventing these damaged proteins from interfering with brain function.(3) BDNF is involved in plasticity and protects the brain from injury by inhibiting apoptosis and stimulating neuronal repair.(3) Due to their role in repairing organic brain pathology, we hypothesized that higher plasma levels of UCHL1 and BDNF would be associated with shorter duration of delirium in critically ill patients.

**Methods**: We enrolled adult patients in respiratory failure and/or shock within 72 hours of being admitted to the medical or surgical ICU. Plasma concentrations of UCHL1 and BDNF were measured upon enrollment. Delirium was assessed twice daily by trained research personnel using the CAM-ICU. Negative binomial regression was used to examine the independent association between biomarker plasma concentrations and delirium, adjusting for severity of illness using cardiovascular SOFA score and APACHE II acute physiology component, baseline cognition using the IQCODE score, comorbid disease using the Charlson score, Framingham stroke risk profile, presence of severe sepsis, and allowing for interactions with age and IL-6 plasma concentration.

**Results**: In our cohort of 419 patients, median (interquartile range) age was 59 (48, 69), 50% were severely septic at enrollment, and the median APACHE II score was 25 (19, 30). 76% of patients developed delirium with a median duration of 3 days (2, 6.5). Higher plasma concentration of UCHL1 was independently associated with shorter duration of delirium (P = 0.036, Figure 1), and this association was not modified by age or IL-6 plasma concentration. There was no association between BDNF plasma concentration and duration of delirium (P = 0.51).

**Conclusion**: Higher plasma concentration of UCHL1, but not of BDNF, is independently associated with shorter duration of delirium in the critically ill. This suggests that increased proteasome pathway activity

in the brain might have a protective effect on acute brain function during critical illness, potentially through increased ability to clear damaged protein aggregates. Further confirmatory studies are needed, including studying UCHL1 plasma concentrations at multiple time points during critical illness to assess whether its association with delirium changes over time in response to disease progression and/or medical therapy.

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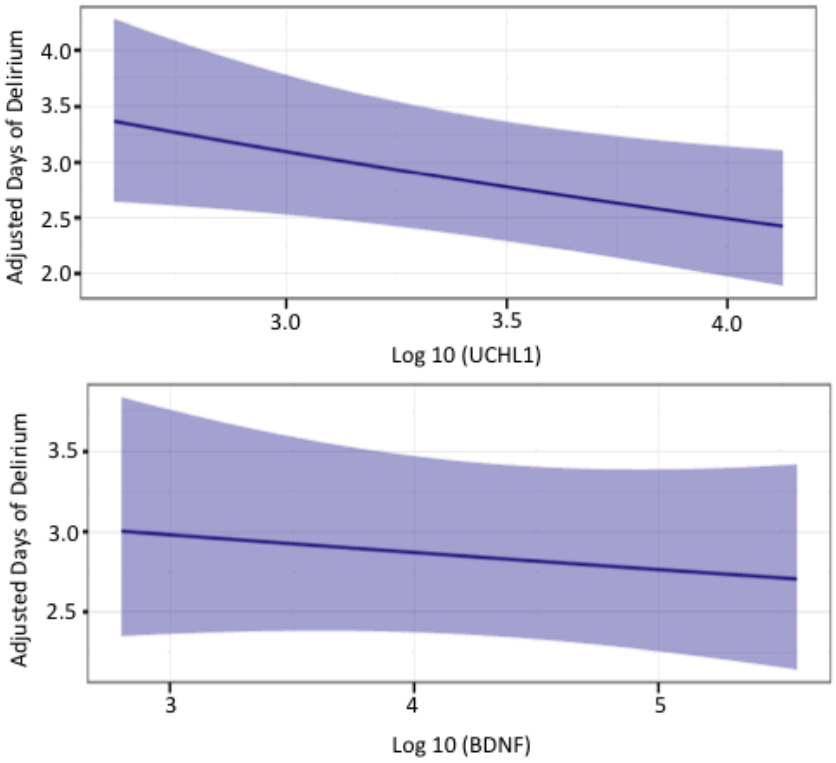
Figure 1: UCHL1 and BDNF vs Delirium Duration



Poster 13

# Outcomes for an Anesthesia Led Regional Mobile ECMO Team

Jacob T Gutsche M.D.; Matthew Williams M.D.; William J Vernick M.D.; Mark E Mikkelsen M.D.; John Haddle B.S.; Wilson Y Szeto M.D.

University of Pennsylvania

**Introduction**: Improved outcomes have been shown when VV ECMO is performed by high volume regional centers1 and an important component of a regional center is a mobile team which can initiate ECMO at outside hospitals in patients too unstable to transport. To meet this need, we designed a multi-disciplinary mobile ECMO team with 24/7 service and the processes to ensure high-quality ECMO delivery. Herein, we report the process and outcomes of our anesthesiologist-led mobile ECMO program.

**Methods**: The team, led by a cardiac-trained anesthesiologist and a cardiac/critical care trained anesthesiologist, included representatives from pulmonary medicine, respiratory therapy, perfusion services, cardiovascular surgery, infectious disease, and nursing. In the 12 months prior to implementing the mobile ECMO program, cardiac surgeons supervised ECMO procedural training to augment the staff capable of initiating ECMO. Pre-implementation, the multi-disciplinary team developed mobile ECMO protocols, including selection criteria. The mobile ECMO travel team consisted of one anesthesiologist and one cardiac surgeon. Following Institutional Review Board approval, we conducted a retrospective cohort study of patients referred for ECMO for acute respiratory insufficiency between January 1st 2015 and December 31st 2015. Safety and outcomes data are presented for the cohort of patients transferred for consideration of ECMO. Comparisons between groups were conducted using Fisher's exact test.

**Results**: A total of 99 consults were received from outside hospitals for consideration of ECMO including 4 patients already placed on ECMO by the referring hospital. After declining ECMO consideration in 35 patients and one patient died within 25 minutes of the initial consultation, 61 were transferred to our institution. Of these 61 patients, 32 were successfully placed on ECMO by our team with a survival to hospital discharge of 68.7% (24/32). Of the 32 ECMO recipients, 21 were performed in mobile fashion with cannulation at the referring hospital by the mobile team. There was no survival difference between patients placed on ECMO at the outside hospital compared to those placed on ECMO post-transfer (14/21 vs. 8/11, p=1.00). Of the remaining 27 patients transferred who did not receive ECMO, 11 met our ECMO exclusion criteria and were supported medically (survival to discharge 27% (3/11)), and the remaining 16 were managed successfully without ECMO and all survived to discharge. Overall, of the 63 patients transferred for consideration of ECMO, 43 survived to discharge (68.2%).

**Conclusions**: To meet the needs of a region, we designed a mobile, anesthesia-led, multidisciplinary ECMO program capable of 24/7 service. In the pre-implementation phase, we focused on procedural training and protocol development for the mobile ECMO team. Post-implementation, we prioritized continuous performance improvement. Our initial results suggest that the structure and process of the program have resulted in a safe and effective program.

**References**:

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# PS01-03: CRITICAL CARE 2

## Posters: 14 - 19

**Moderator: Ranjit Deshpande, MBBS**

Poster 14

# Surveying ICU Nurses Regarding Perspectives on Patient Communication

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**Introduction**: ICU patients have a concerning incidence of depression, anxiety, and post-traumatic stress disorder.[1] For mechanically ventilated (MV) patients, these issues may be compounded by the inability to speak. Some data suggest that engaging in communication with MV patients is also frustrating for caregivers, particularly ICU nursing staff.[2] As part of a project to develop advanced communication technology for these patients, we delivered a survey to ICU nurses across several settings about provider needs and perceptions.[3] The results of this survey will contribute to the final design of a proposed communication system.

**Methods**: After IRB approval and an introduction to the project through a brief presentation, a total of 334 bedside nurses in 6 ICU settings (2 Neuro ICUs, 1 Medical/Surgical ICU, 1 Surgical ICU, 1 Medical ICU, and 1 Respiratory Acute Care Unit) at 2 tertiary care academic medical centers are being administered a 10-12 minute anonymous online survey (REDCap [4]). The survey remains open for two weeks. The questions in the survey include whether nurses could understand MV patients (and have sufficient time to do so); whether these patients and their family members are satisfied with existing communication methods; and whether nurses experience avoidance or frustration when engaging with these patients. Future potential design features of a novel communication system are also a focus of the survey.

**Results**: Analysis from the first surveyed hospital (n=204 nurses in 4 settings) is presented here. Thirty percent of nurses overall started the survey, and 25.5% of nurses completed it. The nurses were highly experienced (17.3 +/- 12.2 years of experience), with the majority of work experience in critical care (14.0 +/- 11.3 years on average).

Nurses were dissatisfied with their ability to communicate with and understand MV ICU patients. Eighty percent of nurses disagreed with the idea that communication methods in use for intubated ICU patients were sufficient. Forty-two percent of nurses disagreed with the statement "I can understand most ICU patients who are unable to speak", while only 2.0% strongly agreed. Eighty percent of nurses agreed with the statement: "Most ICU patients have difficulty communicating their needs when unable to speak", and 63% disagreed with the statement that "Most non-speaking ICU patients are satisfied with the methods of communication used in the ICU" (with another 31% not sure).
Fewer than 40% of nurses agreed that they were completely comfortable communicating with a non-speaking patient, and more than half noted that they avoided some contact with patients who were difficult to understand.

**Conclusions**: There is an urgent need to improve the ability for patients on mechanical ventilation to

communicate with their ICU caregivers. Future research should be directed at the development of assistive communication technology, including how this technology might improve patient outcomes.

**References**:

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2: Am J Crit Care. 2011; 20(2), e28-40.
3: Adapted: MB Happ, UPitt School of Nursing, 2009.
4: J Biomed Inform. 2009; 42(2), 377-81.

Poster 15

# Autoimmune Encephalitis: A Rare Cause of Altered Mental Status and Seizures

Channing Twyner M.D.; Brendan Wanta M.D.

Mayo Clinic

**Introduction**: Altered mental status is a common reason for admission to the intensive care unit. The differential is quite broad and includes metabolic, infectious, malignant, autoimmune, neurodegenerative, vascular, toxins/drugs, psychiatric, and factitious disorders. Autoimmune encephalitis is a rare cause of ICU admission and presents with altered mental status and seizures severe enough to require endotracheal intubation [1]. NMDA receptor and limbic encephalitis are two autoimmune encephalopathies that are easily recognized by classical serologic findings [2-5]. However, over half of autoimmune encephalopathies are seronegative and require careful attention to the clinical course, complications, and other diagnostic features [6]. We report a case of autoimmune encephalitis that was seronegative and improved with early initiation of immunosuppression.

**Case**: A 21-year-old man stationed in the Navy who just returned home presented to an emergency department with fever, nausea, vomiting, and headache, presumably secondary to a gastrointestinal illness. The next day he returned with confusion, memory loss, and severe seizures requiring intubation. A lumbar puncture showed clear fluid with 12 total nucleated cells, protein of 50 mg/dL, and a negative gram stain. HSV and HIV tests were negative. He subsequently developed marked agitation. A MRI brain was consistent with limbic encephalitis, showing increased T2 signal and restricted diffusion in the left medial temporal lobe.

Paraneoplastic and autoimmune panels were ordered but there were no positive serological findings associated with autoimmune encephalitis. He was started on high dose methylprednisolone, intravenous immunoglobulin, and Rituximab. Despite multiple seizure medications, seizure activity and myoclonus continued. He also continued to have paroxysmal sympathetic activity. Finally, plasma exchange was initiated and continued for 5 days. By hospital day 25 his symptoms began to slowly improve.

**Conclusion**: Autoimmune encephalitis is a rare cause of altered mental status requiring intensive care unit admission. However, it should be considered in a patient with severe altered mental status and seizures requiring endotracheal intubation even if common serological test for autoimmune encephalitis are negative. Early consideration and treatment may improve outcome.

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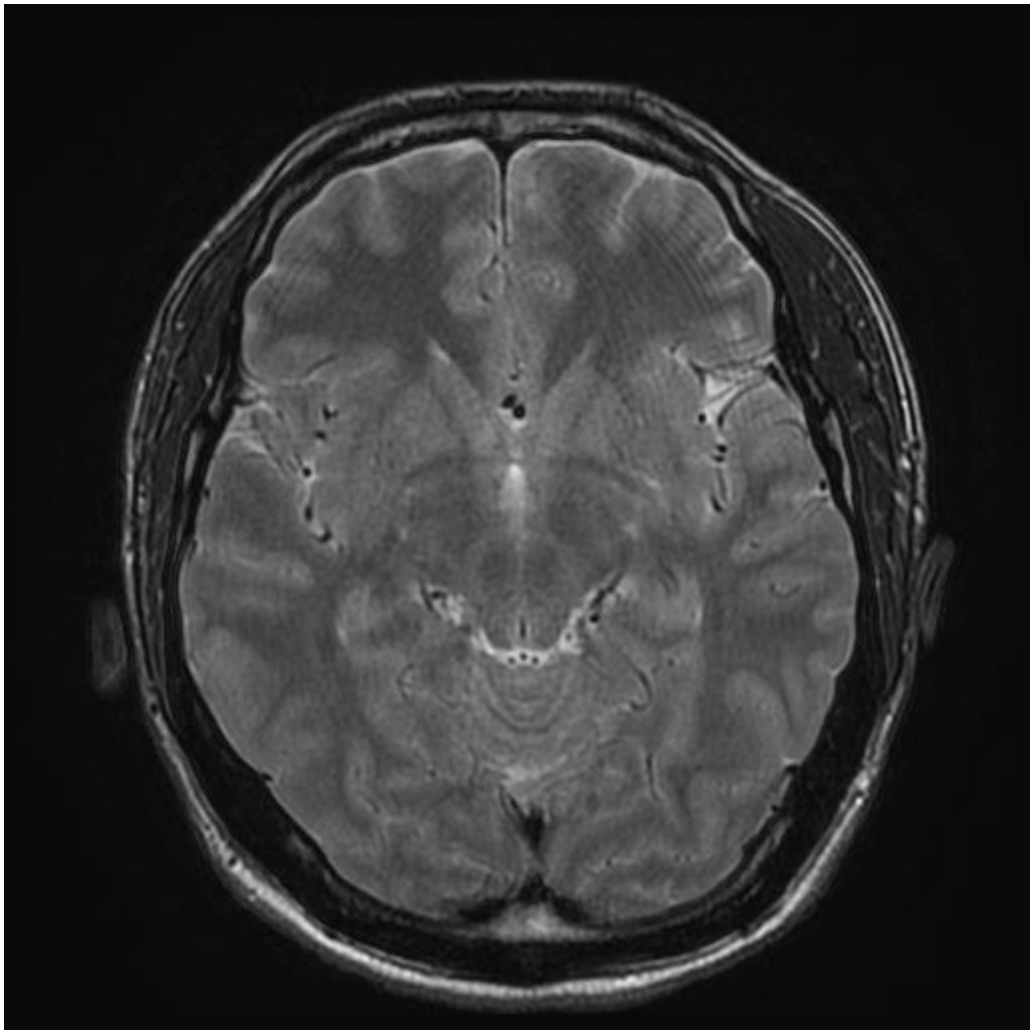

Poster 16

# TandemHeart® as a Bridge to Coronary Artery Bypass Grafting After Out-of-Hospital Cardiac Arrest and Failed Percutaneous Coronary Intervention

Chantel A Gray M.D.; Kathleen Tyson M.D.

Temple University

**INTRODUCTION**: Cardiac shock is the leading cause of death in cases of acute myocardial infarction (MI), with a 30-day mortality between 40-50%. Over the last few years, the management of cardiogenic shock has been altered by the availability of percutaneous circulatory support devices1. There are few randomized trials evaluating the efficacy of these devices for patients not responding to standard cardiogenic shock treatment, and conflicting evidence exists regarding the role of percutaneous circulatory support for patients with out-of-hospital cardiac arrest (OHCA) 2. In our case, the TandemHeart® was used successfully as treatment in refractory cardiogenic shock after OHCA.

**CASE REPORT**: A 64 year old male with past medical history of hypertension, diabetes, and stroke experienced cardiac arrest while driving at work. Colleagues witnessed the patient's motor vehicle accident and activated the emergency contact system. Emergency responders performed resuscitation, including defibrillation, after which the patient was transported to the nearest hospital. He underwent emergent percutaneous coronary intervention (PCI), and was found to have 99% occlusion of the mid-LAD and collateralized RCA occlusion. After unsuccessful attempts at revascularization, an intra-aortic balloon pump (IABP) was placed for cardiogenic shock (CI = 1.3 L/min/m2 with improvement to 1.6 L/min/m2 with IABP), and the patient was transferred to our institution for advanced management. On arrival, the patient was on inotropic support including epinephrine, norepinepherine, and dopamine without hemodynamic improvement. The decision was made to utilize a TandemHeart® as a bridge to definitive treatment. Placement of the TandemHeart® increased the cardiac index to 3.7 L/min/m2, with weaning and eventual removal 3 days later. The patient underwent successful two vessel coronary artery bypass grafting (CABG) the following week.

**CONCLUSION**: Conventionally, the TandemHeart® offers an option for short-term left ventricular support as a bridge to recovery, implantation of a long-term left ventricular assist device, or cardiac transplant1-3. In our case, the TandemHeart® was used as a bridge to CABG after OHCA, failed PCI, and inadequate left ventricular support from an IABP. Current guidelines recommend the use of IABP in the treatment of cardiogenic shock; however, recent study has shown that IABP use does not improve 30-day survival after an acute MI with early revascularization1. When compared to the IABP, the TandemHeart® achieves a greater increase in cardiac output, cardiac index, and mean arterial blood pressure1; as such, the TandemHeart® should be considered as a reasonable option in the treatment of refractory cardiogenic shock.

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Poster 17

# Goal Directed Early Mobilization Reduces ICU Length of Stay and Improves Functional Mobility: An International Multi Center, Randomized, Controlled Trial (SOMS Trial)

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**Introduction**: ICU-acquired weakness (ICUAW) affects short- and long-term patient outcomes. [1] Immobilization leads to ICUAW. In medical ICU patients, early mobilization resulted in improved patient outcomes, [2] but barriers to early mobilization (pain, open wounds, unstable fractures) might exist in the Surgical Intensive Care Unit (SICU).

We tested the SICU Optimal Mobilization Score (SOMS)[3-5] approach to goal-directed early mobilization in a prospective, multicenter, international, randomized, controlled trial.[6]

**Methods**: Following IRB approval and informed consent, mechanically ventilated patients (< 48h at enrollment) expected to require mechanical ventilation for another 24h or more, showing adequate functional independence (Barthel Score ≥ 70) prior to the acute event, were randomly allocated to receive SOMS guided early mobilization[6] or standard of care.

The primary outcome was the mean daily SOMS level achieved, key secondary outcomes were SICU length of stay (LOS), and mini functional independence measure (mmFIM) score representing functional mobility in the domains locomotion and transfer mobility at hospital discharge. We also quantified hospital- and SICU discharge readiness, in-hospital and 3-month mortality as well as discharge disposition.

**Results**: 200 patients were randomized and included in the intention to treat analysis. There were significant differences in the main primary outcome (mean achieved SOMS 2.2 vs 1.5, $p < 0.001$), and in the key secondary outcomes SICU length of stay (10 vs 14 days, $p = 0.03$), and mmFIM at hospital discharge (6 vs 5, $p < 0.001$). In addition, more patients in the intervention group were discharged home (51% vs. 27%, OR 2.8, $p = 0.001$) (Table 1).

**Conclusion**: Goal directed early mobilization shortened SICU length of stay, and improved functional mobility at hospital discharge. In addition, the exploratory analysis revealed that more patients in the intervention group were discharged home.

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5. Journal of Critical Care 2015;30:1251-7.
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**Table 1. Primary and Secondary Outcomes.**

| Variable | Control Group | Intervention Group | Absolute difference | P Value |
|---|---|---|---|---|
| | **(N = 96)** | **(N = 104)** | | |
| **Primary Outcome: mean achieved SOMS level over the course of the ICU stay** | 1.5 ± 0.8 | 2.2 ± 0.9 | 0.7 (0.5 to 1.0) | <0.001 |
| **Key Secondary Outcomes** | | | | |
| ICU LOS | 14 ± 11 | 10 ± 9 # | -3 (-6 to 0) | 0.03 |
| mmFIM at hosptial discharge | 5 ± 3 | 6 ± 2 | 1 (1 to 2) | <0.001 |
| **Secondary Outcomes** | | | | |
| Quality of Life at 3 months after hospital discharge | 108 ± 10 | 107 ± 11 | -1 (-6 to 4) | 0.68 |
| Muscle weakness defined by MRC scale (%) | 27 | 19 | OR 0.62 (0.31 to 1.28) | 0.20 |
| Exploratory secondary Outcomes | | | | |
| ICU LOS until discharge readiness | 13 ± 11 | 10 ± 9 | -3 (-6 to 0) | 0.02 |
| Hospital LOS | 25 ± 17 | 22 ± 20 | -3 (-8 to 3) | 0.34 |
| In-hospital mortality (%) | 8 | 16 | OR 2.1 (0.9 to 5.2) | 0.09 |
| 3-month mortality (%) | 17 | 22 | OR 1.4 (0.7 to 3.0) | 0.35 |
| Discharged Home (%) | 27 | 51 | OR 2.8 (1.5 to 5.0) | 0.001 |

Poster 18

# Managing the Pleural Space When Seconds Count

Laurie Daste M.D.; Philip G. Boysen M.D., M.B.A.

Ochsner Clinic Foundation

**Introduction**: The pleural space is akin to the epidural space as both are potential spaces that can be altered by introduction of blood, fluid or air. When apposition of the visceral and parietal pleural space is violated, life threatening sequelae result requiring an immediate response.

**Methods**: We reviewed data for one year to collect instances when an anesthesiologist acutely intervened to manage the pleural space, with immediate response and removal of air, fluid, or blood required to restore pleural apposition.

**Results**:
Case #1: 57 y/o F transferred to hospital following MVC with rib and spine fractures and bilateral hemothoraces s/p bilateral chest tube placement. CT revealed extrapleural position of R thoracostomy tube into hepatic lobe, and 2nd tube in left hemithorax with visible abdominal contents secondary to diaphragmatic rupture.

Case #2: 50 y/o F with difficult ventilation and intubation during elective mandibular surgery arrived to PACU intubated but unable to be ventilated. Systolic BP in 70s with hyperresonant breath sounds on right. CXR revealed a tension pneumothorax. PEA arrest -> CPR initiated. 14G angiocath inserted into right chest at the bedside with audible release of air. Cardiac and respiratory status immediately improved. 32F chest tube later placed by surgery.

-Consider chest ultrasonography instead of waiting for CXR to confirm diagnosis. U/S has a sensitivity of 87% versus 46% with supine CXR (1). A pneumothorax can be characterized by the absence of: pleural sliding, B-lines, and lung pulse.

Case #3: 51 y/o F s/p ETT exchange at bedside utilizing a cook catheter developed acute desaturation which resolved w/ aggressive ventilation by respiratory therapist. CXR revealed right pneumothorax associated with right mainstem intubation. Withdrawal of tube plus emergent thoracostomy tube placement at 5th intercostal space -> rapid resolution of pneumothorax and clinical improvement.

Case #4: 72 y/o F s/p exlap & open J-tube placement developed sudden respiratory distress and hypotension. Large right pleural effusion on CXR. As a temporizing measure, a Fuhrman pigtail catheter was placed at the bedside (Seldinger technique) with immediate clinical improvement after draining sanguinous fluid. She was never intubated following placement of catheter. Later went to OR for VATS and transferred to floor next day.

-A pigtail catheter can be placed at the fourth intercostal space in the anterior axillary line. Guide a small-gauged needle over the superior border of the 4th rib and aspirate as it's advanced. Once air is aspirated, thread guidewire, and place catheter over wire. Associated with less pain, no tissue

dissection, & no suturing after removal.

**Conclusions**: Anesthesiologists are called upon to function as perioperative physicians and must be prepared with diagnostic and interventional skills to act in emergent and urgent situations as appropriate.

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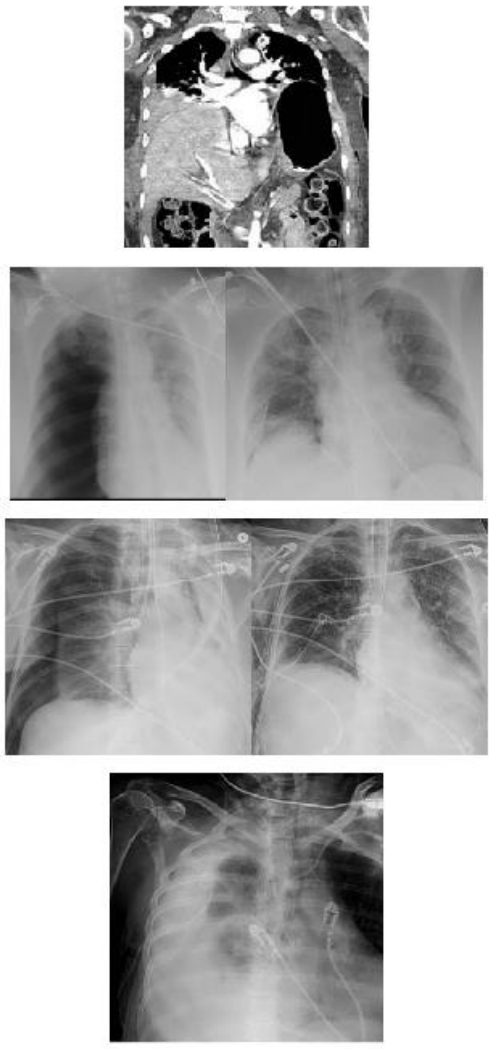

Poster 19

# Prevalence of Spiritual Needs Among Critically Ill Adults and Their Family Members

Josephine Kweku MD, M.P.H.; Malonnie Kinnison M.D.; Sarabdeep Singh Ph.D. ; Rebecca Aslakson M.D., Ph.D.

The Johns Hopkins Hospital

**Introduction**: Quality care, even in the most technically sophisticated environments, involves more than just the physical needs of the patient. Since JCAHO recognized the need for addressing not only the physical but also the spiritual aspects of care (1), hospitals and medical personnel are struggling with how best to address these undeniably important needs. Our aims were to discover how often critically ill patients and/or their family members identify spiritual beliefs as important and whether those spiritual needs are being addressed adequately by home faith community and/or hospital chaplaincy resources.

**Methods**: Cross-sectional survey of adult Intensive Care Unit (ICU) patients and their family members between October 2015 and December 2015. Two study team members surveyed patients and their family members in four adult intensive care units - two surgical ICUs, a medical ICU, and a cardiac care unit which together are comprised of 68 total beds – at a single academic, urban, tertiary care center. Of note, the tertiary care center has a chaplaincy training program and all ICUs had their own assigned chaplain and there was also an in-house, on-call chaplain available 24 hours a day. The study questionnaire was based on the FICA spiritual history tool© (2) and assessed demographic information, including age, race, ethnicity, gender, and faith tradition, as well as the respondent's perceived spiritual needs.

**Results**: There were a total of 144 survey respondents (50% male and 50% female), with the majority of survey participants being Caucasian or African American (68% and 21%, respectively). The most common religious identifications were Christian, Jewish, or no faith tradition (76%, 8%, and 11%, respectively). In total, 123 (85%) of the respondents identified that spirituality was important to them in times of crisis and of these 123 respondents, 111 (90%) were satisfied with the spiritual care they received while in the ICU, be it from hospital chaplaincy services or their home faith community. Of note, 12 respondents were identified as having spiritual needs that were not being met by their home faith community or the hospital chaplaincy service and of these respondents, all identified as Christian and 75% identified as Caucasian.

**Conclusion**: A high prevalence (85%) of critically ill patients and family members identified having spiritual needs during the period of critical illness, though the vast majority (90%) felt that their spiritual needs were being met with current resources at a hospital with assigned ICU-based chaplains and an always available, on-call, in-house chaplain. Future research is needed into how the spiritual support provided by a community pastor or religious community differs in content or effectiveness from that provided by the hospital chaplain. The high prevalence of spiritual needs of critically ill patients and their family members emphasizes the importance of having chaplaincy resources available in critical care units.

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# PS01-04: CRITICAL CARE 3

## Posters: 20 - 25

**Moderator: Brenda G. Fahy, MD, MCCM**

Poster 20

# Acute Cor Pulmonale in Venovenous Extracorporal Membrane Oxygenation

Erik R Dong D.O.[1]; David Ng M.D. [1]; Joshua Chung M.D. [1]; Francisco Arabia M.D. [1]; Danny Ramzy M.D., Ph.D. [1]; Michael Nurok M.B.Ch.B., Ph.D. [1]; Alain Combes M.D., Ph.D.[2]

Cedars Sinai Medical Center[1]; La Pitie Salpetriere[2]

Acute cor pulmonale (ACP) is defined as right heart failure resulting from a disorder of the lung and not a consequence of left ventricular failure, congenital disorders or valvular pathology. There is no literature evaluating ACP in patients with Acute Respiratory Distress Syndrome (ARDS) on VV ECMO. Here we explore the right ventricular (RV) function in three ARDS patients on VV ECMO who developed ACP and propose potential mechanisms.

A retrospective review of three patients with ARDS and normal baseline RV function admitted to the ICU at Cedars Sinai for VV ECMO between July-December 2015. These patients developed ACP while on VV ECMO. Standard Berlin Criteria definitions were used in the diagnosis of ARDS and all patients were cannulated with a dual lumen (Avalon) cannula with outflow directed across the tricuspid valve (TV). Records were reviewed with analysis of lab data, clinical notes, imaging and hemodynamic values. The case series was approved by the IRB.

1. A previously healthy 32-year-old male, presenting with cough, fever and hypoxemia necessitating VV ECMO. On admission, and placement of ECMO, echo demonstrated normal RV systolic function with normal appearance of the TV and mild tricuspid regurgitation (TR). Six weeks later, ACP was diagnosed in the setting of hemodynamic instability by echo findings of moderate depression of the RV systolic function with severe TR, estimated PA pressures at 86.0mmHg and IVC dilation. The patient died of multi-organ failure despite aggressive inotropic support and iNO.

2. A 59-year-old male with HTN, CKD admitted for bowel obstruction and severe ARDS post aspiration. Post cannulation echo revealed normal biventricular function with no valvular abnormalities. One month into the patient's course ACP was diagnosed in the setting of hemodynamic instability based on findings of a severely dilated RV and IVC with moderately depressed systolic function and estimated PA pressures of 75mmHg in the absence of any identifiable cause. The patient died of multi-organ failure despite aggressive inotropic support and iNO.

3. A 23-year-old previously healthy male developed ARDS of unknown etiology. Initial echo noted normal RV size and function with the absence of TV pathology. This patient's course was complicated by GI bleeds, seizures, and cholecystitis. ACP was diagnosed in the setting of hemodynamic instability one month after cannulation based on echo findings of a dilated RV with moderately depressed systolic function, flattening of the interventricular septum and TR. RV function improved with inotropic support and at the time of this report the patient was being evaluated for lung transplant.

Despite variations in history, presentation and course, similar findings of ACP were prevalent in these 3 cases of VV ECMO four to six weeks following cannulation with an Avalon catheter. Potential

mechanisms for ACP include pulmonary emboli, hypoxia/hypercapnia, fibrotic changes in the lung, and or adverse effects of chronic cannula flow across the TV. Further research is required to confirm a causal relationship and mechanism for ACP in VV ECMO. If ACP is a result of persistent high non-physiologic flow across the TV into the RV, alternative cannulation strategies for VV ECMO would be warranted.

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## *Young Investigator Award*

Poster 21

# A Novel Association Between High Density Lipoprotein Levels and the Risk of Acute Kidney Injury After Cardiac Surgery

Loren E Smith M.D., Ph.D.; Derek K Smith D.D.S.; MacRae F Linton M.D.; Frederic T Billings IV M.D., M.Sc.

Vanderbilt University Medical Center

**Introduction and General Purpose of the Study**: Acute kidney injury (AKI) after cardiac surgery occurs in up to 30% of patients and is an independent predictor of death.1 HDL has known anti-oxidant and anti-inflammatory properties and may attenuate mechanisms of AKI.2 We hypothesized that a high preoperative HDL cholesterol concentration is protective against postoperative AKI.
Methods: After IRB approval, data were obtained from a prospective, 393-subject trial of perioperative atorvastatin to prevent post-cardiac surgery AKI. Statin-using patients were randomized to placebo or 80mg atorvastatin the morning of surgery and 40mg on postoperative day 1. Stain-naïve patients were randomized to placebo or 80mg the day prior to surgery and 40mg daily thereafter during hospitalization. The association between HDL level and maximum serum creatinine change from baseline in the first 48 postoperative hours was assessed using a two-component latent variable mixture model and AKI risk factors. Regression analyses assessed interactions of chronic statin use, perioperative atorvastatin treatment, and HDL level on AKI risk.

**Results and Major Findings**: Postoperative AKI occurred in 99 patients (25.2%). Median (10th, 90th percentile) preoperative HDL was 37.6 (25.0, 54.0) mg/dl and postoperative creatinine change 0.09 (-0.11, 0.59) mg/dl. Lower HDL levels were independently associated with increased creatinine rise (p=0.02) (Figure 1A). Regression analysis showed this association was present in statin-using but not statin-naïve patients (p=0.008) (1B). The protective effect of high HDL in chronic statin users was enhanced with perioperative atorvastatin treatment (p=0.004) (1C) and with increasing chronic statin dose (p=0.003) (1D). Similar analyses using LDL found no association with postoperative AKI risk (p=0.51).

**Conclusions**: Higher preoperative HDL was associated with less risk of AKI. Statin exposure modified this association. Specifically, subjects with higher HDL levels on chronic statin therapy had less creatinine rise and appeared to further benefit from higher chronic statin dose and perioperative atorvastatin therapy. These findings support a possible pleotropic effect of statins on HDL in the context of AKI and a potential new role for HDL during the perioperative period. Future work involves identifying the biological mechanism underlying these associations.

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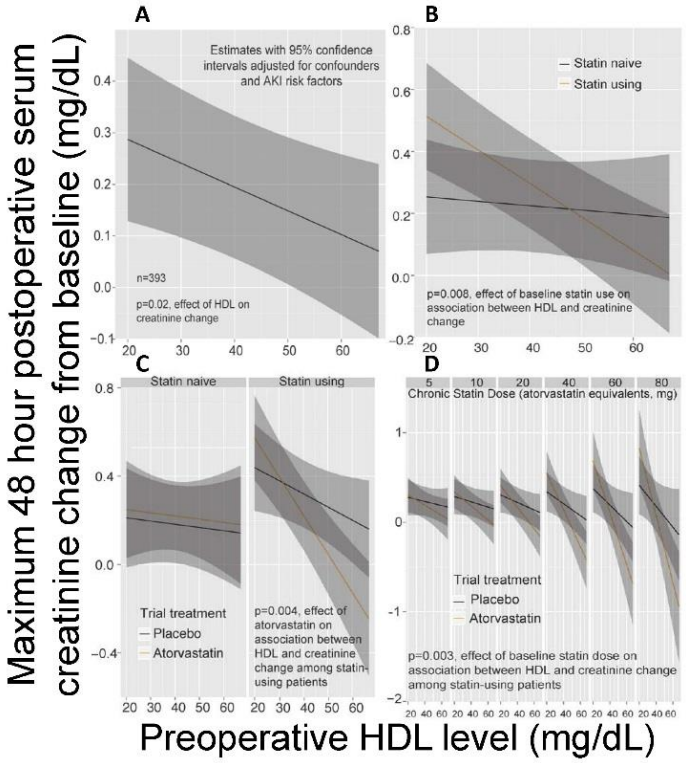

Poster 22

# A Combined Heart-Liver Transplant in a Patient With Latent Tuberculosis: Basic Management and Control of Post-operative Events

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Combined heart and liver transplant surgeries are uncommon. In the United States there have been a total of one hundred eighty four combined heart and liver transplants since 1988 (1). Statistically, the male to female ratio is roughly 2:1 and the most common age range is from fifty to sixty-four years. There are currently no reports on critical care management of patients who have had a combined heart and liver transplant. Recently a combined heart and liver transplant was performed at our center. A forty-two year-old male was admitted to the cardiac intensive care unit after receiving an orthotopic heart and liver transplant. His past medical history was significant for ischemic cardiomyopathy with a left ventricular ejection fraction of fifteen percent, cirrhosis secondary to hepatitis C (MELD of sixteen), arterial hypertension, atrial fibrillation, diabetes, stroke, chronic kidney disease and latent tuberculosis on treatment prior to surgery. After transfer of the patient from the operating room to the ICU, hemodynamic monitoring was initially performed using a pulmonary artery catheter, arterial lines (radial and femoral), electrocardiogram, bladder pressure monitoring, urinary catheter and scheduled hourly nursing evaluations and labs. Fluid status was a delicate balance so as to maintain adequate preload for the transplanted heart and liver but not congest either at the expense of the other. Pulmonary artery catheter numbers (maintaining a cardiac index greater than 2.0), urine output, heart rate and blood pressure guided the pressor and fluid administration. Post-surgical cardiac function was also determined using transthoracic echo. He was placed on nitric oxide immediately post-op secondary to mild right ventricular dysfunction and elevated pulmonary artery pressures. The patient had both episodes of ventricular tachycardia and atrial fibrillation that were controlled pharmacologically. Liver ultrasound with Doppler analysis of arterial and venous flow was performed on postop day one and ten. Kidney function was determined using intermittent labs, urinary electrolytes and evaluation from the transplant nephrology service. Coagulation disorders are common after cardiopulmonary bypass and liver transplantation. The patient developed heparin induced thrombocytopenia and was started on bivalirudin. Transplant infectious disease was consulted for adequate antibiotic, antifungal and antiviral therapy as the patient was being treated not only for transplant prophylaxis but also for latent tuberculosis. Isoniazid was restarted once liver function tests started to normalize. Later in his postoperative course, the patient presented with sepsis of unknown origin and was treated with broad-spectrum antibiotics. After the patient spent 16 days in the ICU he was transferred to the general hospital floor. Few of these cases have been done worldwide. It is of utmost importance that all of the teams in charge of the patient maintain a good line of communication. The use of specialized services such as transplant surgery (both heart and liver), intensive care, gastroenterology, nephrology and infectious disease is an asset that needs to be available in centers performing this type of procedure.

Poster 23

# Takotsubo Cardiomyopathy: A Ten-Year Retrospective Review of the Clinical Course and Outcome at a Large Academic Medical Center

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Cedars-Sinai Medical Center

**Introduction:** Takotsubo cardiomyopathy (TC) is a disease triggered by physical or emotional stress. 1 TC patients often present with chest pain, dyspnea, and syncope. Clinical presentation often mimics Acute Myocardial Infarction.2 TC may be complicated by mitral regurgitation, thrombosis and heart failure. 3 TC triggers include critical illness, such as septic shock, metabolic abnormalities and neurologic disorders. 4, 5 Intensive Care Unit patients are at high risk for the development of TC. 6 Intensivists should be familiar with this diagnosis. We investigated TC patients at our institution over a ten- year period including clinical presentation, laboratory findings, echocardiographic findings, and outcome.

**Methods:** With institutional IRB approval, we retrospectively reviewed the medical records of TC patients. Sixty-four patients were diagnosed with TC between September 2007 and January 2016. TC triggers, clinical symptoms, comorbidities and outcome were reviewed. The most recent echocardiogram was analyzed and compared with findings at the time of TC diagnosis. EZR (Saitama, Japan) was used for statistical analysis.

**Results:** 89.0% of patients were female (57 vs 7) The average age was 68.3±15.0 years old. Presenting symptoms were: Dyspnea (50%), Chest Pain (40.6%) or both (21.9%). TC was an incidental finding in 31.3% of cases (20 patients).

Leukocytosis ( WBC 12.5±6.6 ×103 per/µl) and elevated troponin level (6.65±19.2 ng/ml) were common findings. The electrocardiogram showed ST elevation (25%) and/or T wave changes (69%). QT interval was prolonged (485.3 ±52.4 msec). Left Ventricle (LV) Ejection fraction was 34.±11.9% at TC diagnosis. Mitral regurgitation was common. 7.8% of patients had LV Outlet Obstruction with systolic anterior motion (SAM) of the anterior leaflet of mitral valve. Thrombosis was a complication in 3.1% of patients. TC triggers included: physical stress related to the current medical condition (68.8%) or emotional stress (7.8%) of patients. Medical conditions triggering TC were infection, physical trauma, and recent surgery. 50% of patients underwent left cardiac catheterization. 9.4% underwent non-invasive cardiac imaging. LV ejection fraction recovered to 59.6±9.9 %. Only one patient (1.6%) presented with cardiac arrest and died as a result of TC.

**Conclusion:** Our study showed the rate of LV thrombosis is very low. However, anticoagulation is an important treatment. 7 Existing literature states that emotional stress is as common as physical stress as a TC trigger. 2 Physical stress was more common in our institution. TC is a largely reversible disease with a favorable outcome and should be considered as an etiology of severe LV dysfunction in critically ill patients suffering either physical or emotional stress.

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Poster 24

# Association of Endothelial and Neurologic Injury Biomarkers with Cognitive Impairment After Critical Illness

Christopher G Hughes M.D.; Timothy D Girard M.D.; James C Jackson M.D.; Jennifer L Thompson M.P.H.; E Wesley Ely M.D.; Pratik P Pandharipande M.D.

Vanderbilt University

**Introduction and General Purpose of the Study**: Delirium in the hospital is one of the strongest predictors of cognitive impairment after critical illness.(1) Endothelial dysfunction may lead to delirium via perturbations in microvascular blood flow, release of biochemical mediators, or breakdown of the blood brain barrier (BBB).(2) Neuronal alterations from this acute insult may manifest as cognitive impairment in the long-term. We have shown that elevated plasma concentrations of endothelial activation and neurologic (BBB and brain) injury biomarkers are associated with prolonged delirium duration in critically ill patients.(3) The relationship of these biomarkers with cognitive impairment after critical illness has not been examined. We hypothesized that elevated plasma concentrations of endothelial activation (E-selectin and PAI-1), BBB injury (S100B), and brain injury (UCHL1 and BDNF) biomarkers would be associated with worse cognitive impairment after critical illness.

**Methods**: The BRAIN-ICU study enrolled adult patients within 72 hours of respiratory failure or shock admitted to a medical or surgical ICU. We measured plasma concentrations of E-selectin, PAI-1, S100B, UCHL1, and BDNF upon enrollment. At 3 and 12 months after hospital discharge, global cognition was assessed with the Repeatable Battery for the Assessment of Neuropsychological Status.(4) We used multivariable linear regression to examine the independent associations of endothelial activation, BBB, and brain injury biomarkers with global cognition scores, adjusting for education, baseline cognition, comorbid disease, severity of illness, severe sepsis, delirium, and coma and allowing for interactions with age and systemic inflammation (IL-6 plasma concentration).

**Results and Major Findings**: Our study included 392 survivors of critical illness who underwent post-discharge cognitive assessment. The patients had a median age of 59 years and APACHE II score of 25, with 91% requiring mechanical ventilation, 65% having severe sepsis, and 76% developing delirium during the study. In general, higher S100B concentrations were associated with worse global cognition at both 3 and 12 months (overall P=0.057; P=0.005); these associations were modified by age and IL-6 such that the strongest associations were seen in younger patients and those with high inflammatory burden (Figure 1). Higher E-selectin (P=0.016) and UCHL1 (P=0.011) concentrations were associated with worse global cognition at 3 months but not 12 months and not modified by age or IL-6. No significant associations were found between PAI-1 and BDNF concentrations with global cognition.

**Conclusions**: These data support that BBB injury biomarkers are associated with long-term cognitive impairment after critical illness, in particular in younger patients and high inflammatory states. Endothelial activation and brain injury biomarkers may be associated with short-term cognitive impairment. Further confirmatory studies are needed, including serial evaluations of biomarker

concentrations to assess whether these associations change in response to disease progression or medical therapy.

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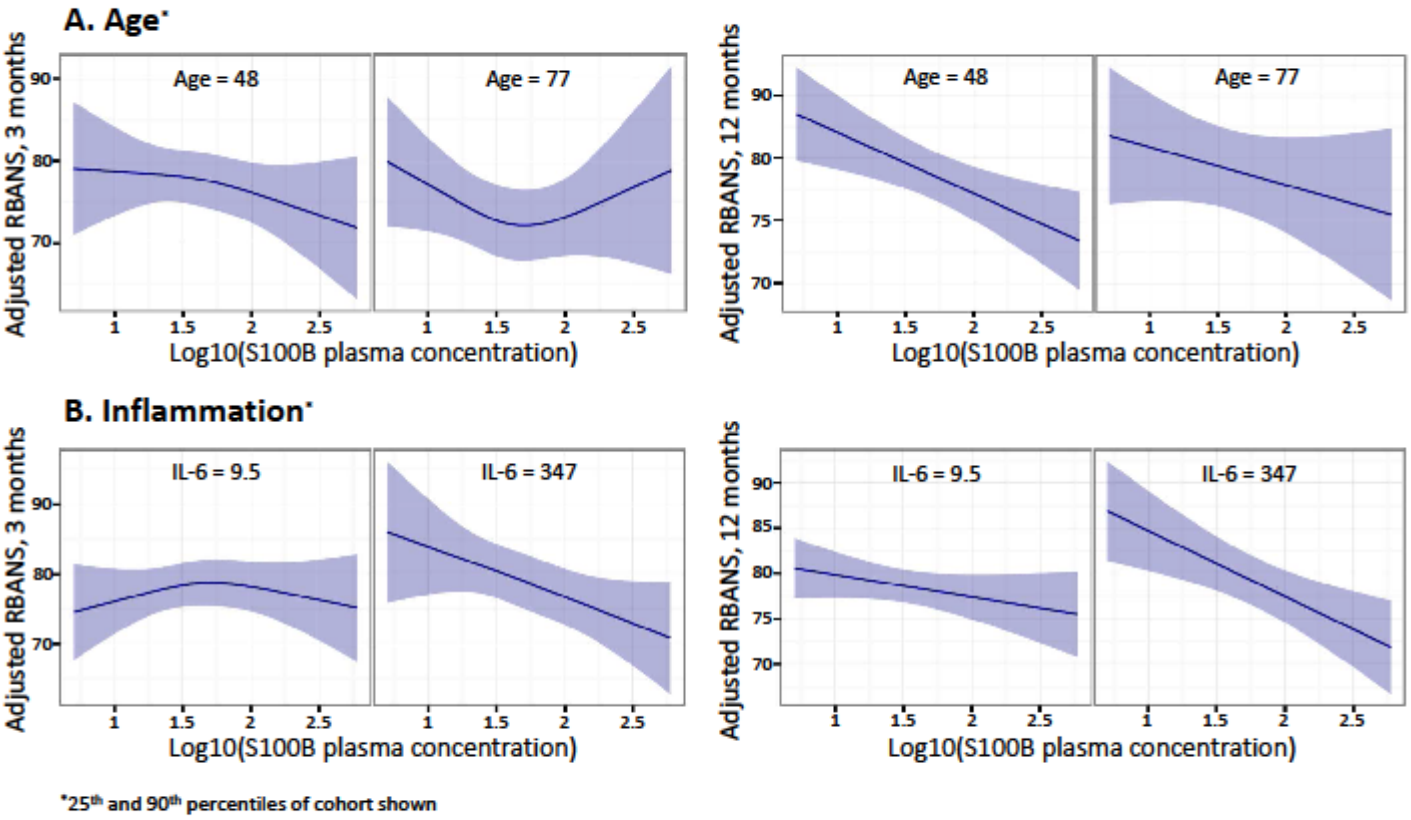
**Figure 1. S100B versus Global Cognition by Age and Inflammation**




*25th and 90th percentiles of cohort shown

Poster 25

# Initial Experience With a Mandatory Extubation Safety Risk Assessment Checklist Incorporated Within a CPOE-Based Order for Tracheal Extubation

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University of Washington

**Background**: Fifteen to 20% of intubated and mechanically ventilated patients in the intensive care unit (ICU) will require re-intubation after extubation due to an unrecognized need for continued positive pressure ventilation or the presence of an artificial airway.1,2 Apart from its association with an increase in hospital length of stay and mortality,1 reintubation in patients with difficult airways or with acute airway obstruction may be immediately associated with airway-related complications. Our primary aim was to create an electronic tracheal extubation order set, which incorporates an extubation failure risk assessment checklist, completion of which is mandatory for order signature, and describe our initial experience.

**Methods**:
An extubation risk assessment tool, originally conceived for a prior quality improvement project, was modified into a decision support tool within the electronic medical record based order for tracheal extubation (Figure 1). After staff was educated regarding its purpose and use, it became the sole order available for extubation of the adult ICU patient at our institution excepting that contained in the comfort care order set. All patients who were considered high-risk were evaluated by the Anesthesiology-based airway team prior to extubation. Data from templated respiratory therapy notes, including the results of spontaneous breathing trials and post-extubation assessments, risk-stratification assessments, details of episodes of reintubation were collected in a quality improvement database for review. Data is presented as N (%), mean (SD), or median (range) unless otherwise noted.

**Results**:
Between August and November, 2015, 463 extubations took place. The risk stratification tool was completed for 441/463 (95%) of extubations. Overall, 236 (53.5%) were classified as low risk, 441 (29.7%) were classified as intermediate risk, and 74 (16.7%) were classified as high risk. In total, 41 (9.3%) patients were reintubated: 21 (8.9%) low risk, 13 (9.9%) in the intermediate risk, and 7 (9.5%) in the high risk. The median time to reintubation, in hours, was 24 (1.5-433) in the low risk, 11(0.3-158) in intermediate risk, and 27 (0.2-257) in the high risk. There was no significant difference in the number of intubation attempts, the intubation device utilized and the training level of the provider between the three groups.

**Discussion**:
Implementation of a mandatory risk-stratification tool to identify patients at risk for extubation failure and/or difficult airway on reintubation was associated with reintubation rates lower than historical controls in a single institution. In addition, reintubation was generally uncomplicated. However, our tool did not correctly stratify patients into ultra-early (<6 hours), early (<24 hours), or late (>24 hours)

failures. Further examination of our data is needed to address the accuracy and precision of our tool.

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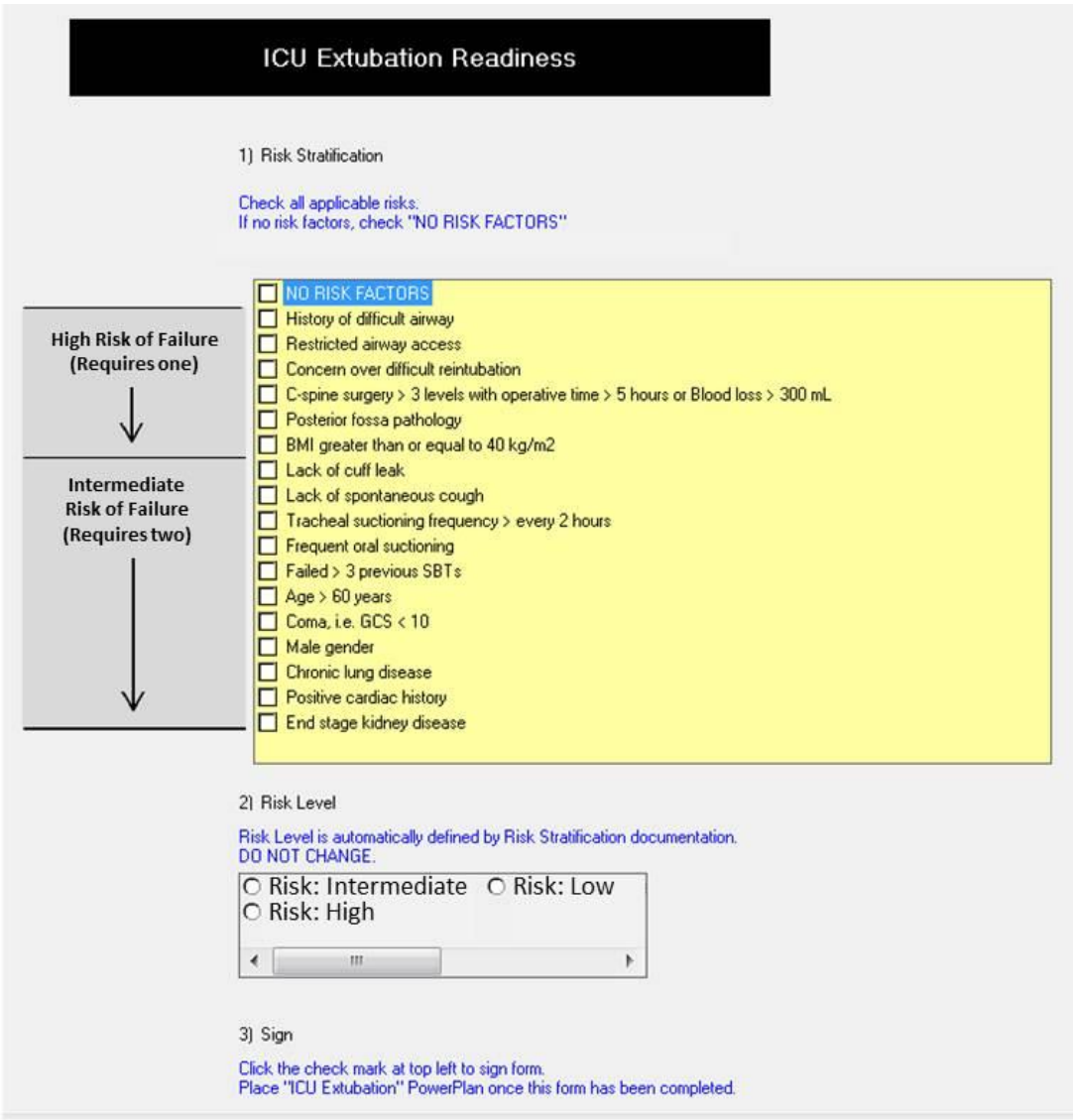


Figure 1: Computerized order entry-based risk-stratification tool for extubation in the intensive care unit

# PS01-05: MEDICALLY CHALLENGING CASES 1

## Posters: 26 - 31

**Moderator: Dragus M. Galusca, MD, FCCP**

Poster 26

# Dynamic Airway Collapse: A Unique Presentation

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**Introduction**: Pathologic dynamic airway collapse is caused by a compromise in the structural integrity of the trachea or bronchi and may lead to significant airway obstruction. These conditions are divided into congenital, acquired and idiopathic categories. Both adults and children can be affected and may present with airway management challenges.

**Case Description**: The following is the case of a 63-year-old 113 kg male with copious secretions and hypoxic respiratory failure in the ICU after an extracranial-intracranial bypass of a basilar artery aneurysm. His past medical history includes hypertension, asthma, type II diabetes mellitus, heart failure, and brainstem infarcts with left-sided hemiparesis and dysphagia. During his previous intubation a grade II airway was identified with no air leak around the 7.5 mm ID endotracheal tube (ETT).

In the ICU the patient was reintubated with a 7.5 ETT without difficulty. A persistent cuff leak was identified and the ETT was replaced with a second 7.5 ETT due to presumed cuff insufficiency and then an 8.0 ETT but the leak persisted. An acquired tracheoesophageal fistula was high on our differential and our goal was to advance the cuff of the ETT past the fistula to minimize further aspiration and optimize ventilation.

The 8.0 ETT was repositioned above the carina under fiberoptic guidance and then into the right mainstem bronchus in an attempt to exclude the leak, however, the leak persisted and no source was identified visually. A 39f double lumen ETT was then placed under fiberoptic guidance isolating both the left and right bronchi without resolution of the leak. The bronchial and tracheal balloons were inflated and both lumens left patent with disappearance of an audible leak but persistence of a 6 cc measureable leak.

Following failure of multiple spontaneous breathing trials, an 8.0 mm cuffed tracheostomy tube was placed surgically. Diffuse collapsing of the trachea and bilateral bronchi were noted on fiberoptic bronchoscopy during spontaneous ventilation, which is the diagnostic gold standard for dynamic airway collapse [1].

**Discussion**: Tracheomalacia (TM) exists in both congenital and acquired forms and refers to a weakness of the trachea and/or bronchial trees, due to a reduction or atrophy of the longitudinal elastic fibers of the pars membranacea such that the airway is softer and more susceptible to collapse. As an acquired disease degeneration of cartilaginous airway support may occur secondary to external airway compression, airway manipulation and chronic pulmonary disease [1].

Other conditions affecting airway integrity include the idiopathic giant trachea syndrome and excessive dynamic airway collapse (EDAC). Distinctly different in etiology from TM, where the cartilaginous rings are affected, EDAC describes an exaggeration of the normal anterior motion of the posterior tracheal

wall on exhalation leading to airway obstruction [2, 3].

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Poster 27

# Bovine Hemoglobin in Place of Human Blood in Jehovah's Witness: A Case Report

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A 65 year old female Jehovah's Witness was transferred to our hospital for ischemic stroke after undergoing hysterectomy for vaginal bleeding at an outside hospital. She had suffered hypoxic brain damage following exsanguinating uterine bleeding and refused to receive blood transfusions. Upon admission to our hospital even though she was hemodynamically stable and external signs of bleeding had ceased, progressive hemodilution and inability to transfuse red cells combined to drop her hemoglobin to 4.7g/dl. At this point, hemorrhagic shock had led to progressive mental decline and coma associated with MRI-documented cerebral hypoperfusion with multi-infarct.

Management at this point included maximizing erythropoiesis by the bone marrow, including Darbopoetin, iron sucrose, vitamin B12 and folate. Intubation to reduce oxygen requirement was performed and consultation from hematologist was obtained. A decision was made to use compassionate SANGUINATE. This product, created by Prolong Pharmaceuticals, is a PEGylated carboxyhemoglobin bovine. The functional components of SANGUINATE are: Carbon mono-oxide, bovine hemoglobin, and polyethylene glycol. PEGylated carboxyhemoglobin bovine works by first releasing carbon monoxide from the hemoglobin molecule which then permits the binding and transfer of the oxygen molecule. The ability of Sanguinate to actively transfer oxygen to hypoxic tissue is based on it p50 value of 7-16 mm Hg (normal Hb p50: 26). This low p50 allows Sanguinate to unload the oxygen molecules in ischemic tissues which has an even lower p50 of below 5. It is theorized to inhibit vasoconstriction, decrease extravasation, limit reactive oxygen species production, enhance blood rheology, and deliver oxygen to the tissues.

It is not currently approved by FDA but it is available for compassionate use from the manufacturer. Animal models of cerebral ischemia, peripheral ischemia, and myocardial ischemia have demonstrated SANGUINATE's efficacy in reducing myocardial infarct size, limiting necrosis from cerebral ischemia, and promoting more rapid recovery from hind limb ischemia. In a Phase I trial, three cohorts of eight healthy volunteers received single ascending doses of 80, 120, or 160 mg/kg of SANGUINATE. Two volunteers within each cohort served as a saline control. There were no serious adverse events. Serum haptoglobin decreased, but did not appear to be dose related. The T1/2 was dose dependent and ranged from 7.9 to 13.8 h. SANGUINATE was found to be safe and well tolerated in a Phase I clinical trial, and therefore it will advance into further clinical trials in patients.

Poster 28

# Use of Transthoracic Thermodilution Measurements to Guide Management of Postoperative Cardiogenic Shock

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University of Texas Medical Branch[1]; Medical University of South Carolina[2]

This case report describes the complicated postoperative course of a 73 year-old male patient with a history of paroxysmal atrial fibrillation and congestive heart failure from ischemic cardiomyopathy. He presented with benign biliary stricture and underwent an uneventful hepatico-jejunostomy for recurrent choledocholithiasis. The postoperative period was complicated by hemodynamic and respiratory failure requiring endotracheal intubation and vasoactive support. An initial chest x-ray revealed right lower lobe consolidation and mild interstitial edema that was possibly indicative of aspiration. Notable lab results include a troponin that peaked at 17.04, mild leukocytosis and a procalcitonin peak of 14. Initial transthoracic echocardiography (TTE) showed global hypokinesis with an estimated ejection fraction (EF) of less than 20%. Concern for sepsis prompted broad-spectrum antibiotic coverage.

Given the conflicting clinical picture, a 20 gauge thermistor arterial catheter (PiCCO Pulsion®) was placed to guide management of what was ultimately determined to be cardiogenic shock. The choice of catecholamines and antiarrhythmic drugs, together with repeated attempts of cardioversion, was guided by transthoracic thermodilution measurements. The transthoracic thermodilution initially revealed a significantly reduced cardiac index of 1.6 [l/min * m2], global end-diastolic volume index (GEDI) within the upper range of normal values with slightly elevated extravascular lung water, indicating mild cardiogenic pulmonary edema. Systemic vascular resistance was near the upper range of normal values. Stroke volume was severely reduced due to supraventricular tachyarrhythmia, though improved after cardioversion. Despite the concern for sepsis, the patient did not have a fever, positive cultures or other indicators of infection. Therefore, controlled preload reduction while continuously measuring GEDI and CFI and maintaining the norepinephrine and vasopressin administration was initiated. Based on the interpretation of CFI and the hemodynamic parameters observed, this was deemed to be appropriate. Although the GEDI was found to be within the normal range at the beginning of this attempt, the CFI improved slightly after a dose of 20 mg Furosemide. As GEDI was reduced from 702 ml to 609 ml, the CFI was found to be plateauing greater than 3 and was considered to be the best possible result under the given circumstance. Hemodynamic function continued to improve, as noted by a down trending troponin and decreased need for catecholamine support. TTE repeated seven days post-operatively revealed an improved EF to nearly 50%.

This patient with severe postoperative hemodynamic failure was clinically challenging because his condition could have been interpreted as an exacerbation of congestive heart failure, postoperative systemic inflammatory response, sepsis, or even a pulmonary embolus. Thus, the underlying pathophysiology would have required different strategies of fluid management and pharmacologic approaches. Therapy guided by determination of GEDI, extravascular lung water, thermodilution-calibrated pulse-contour derived continuous cardiac output, as well as CFI was deemed to be advantageous for management of this clinically challenging patient.

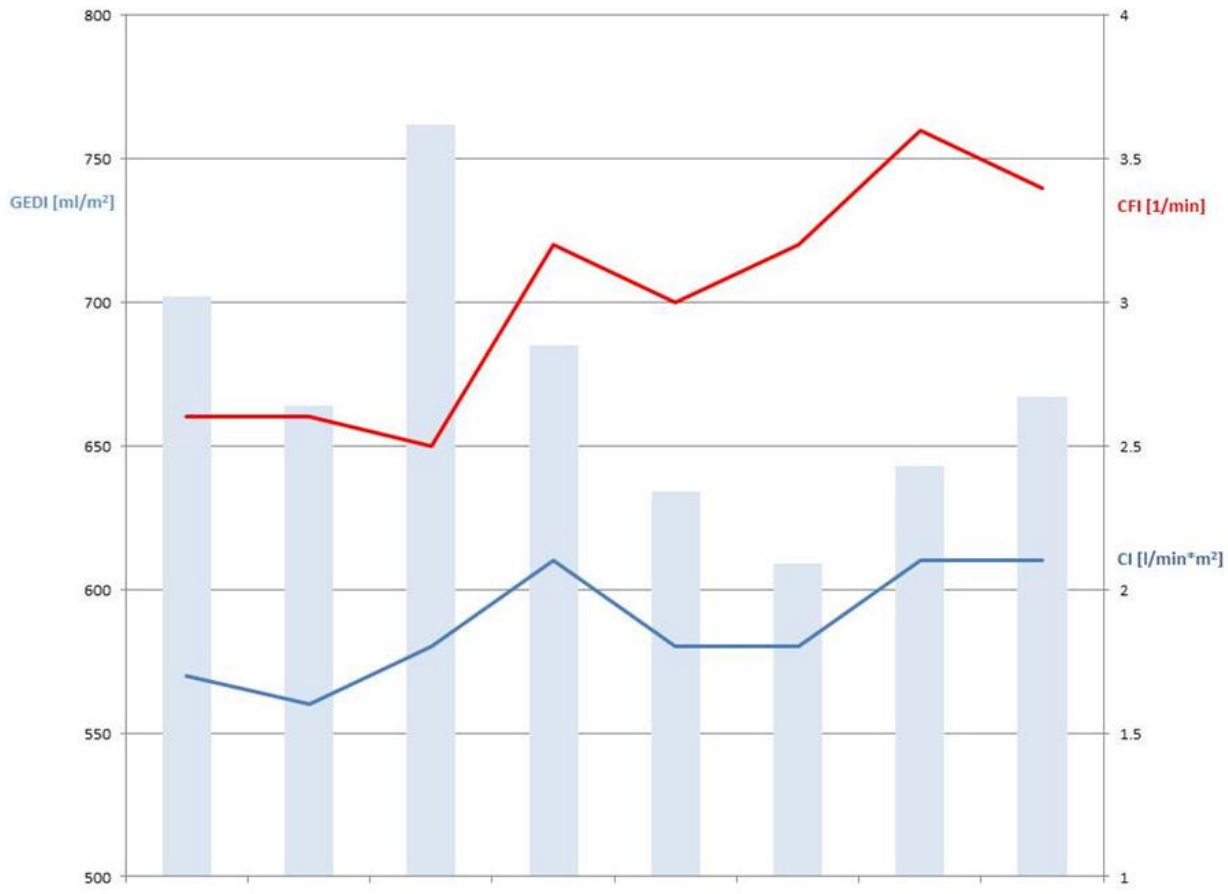


*Fig. 1. The graph shows the time course of Cardiac Index (CI- blue curve), Cardiac Function Index (CFI- red curve), and global end-diastolic volume (GEDI - light blue bars) measured in intervals of 4 hours. In spite of overly unchanged CI the CFI improved due to controlled reduction of preload in terms of global end-diastolic volume to even subnormal values to improve cardiac function.*

Poster 29

# Pericardial Thrombus Formation After Aortic and Mitral Valve Replacement Causing Acute Tamponade Physiology

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Mayo Clinic

**Introduction**: A rare, but life-threatening complication associated with open valve replacement surgery is clinically significant cardiac tamponade. The bedside diagnosis of cardiac tamponade can be delayed due to challenging diagnostic imaging conditions in the postoperative period, which can result in hemodynamic instability and subsequent morbidity 1. Most case reports of cardiac tamponade in the literature involve cardiac catheterization or pacemaker placement procedures and are precipitated by either coronary artery or ventricular wall rupture 2. Here, we present a case of acute pericardial tamponade following valve replacement surgery due to a pericardial hematoma obstructing right atrial filling.

**Case Report**: A 53-year-old woman with history significant for Hodgkin's lymphoma presented with symptomatic, radiation induced heart disease. Preoperative echocardiogram was significant for severe aortic valve stenosis and severe mitral valve calcification with regurgitation. Due to worsening dizziness and dyspnea, the patient underwent aortic and mitral valve replacement. An immediate post-cardiopulmonary bypass echocardiogram was unremarkable. The patient was hemodynamically stable and transferred to the intensive care unit. Throughout the evening, the patient had progressively increasing vasopressor requirements and declining urine output. Physical exam was significant for bulging neck veins, distant heart sounds, and cyanotic extremities. A transthoracic echocardiogram was urgently obtained, which showed a coagulated thrombus in the pericardial space causing external compression of the right atrium (figure). The patient was emergently taken back to the operating room for hematoma evacuation and repair of a bleeding coronary artery. Her hemodynamics significantly improved after thrombus extraction.

**Conclusions**: Although pericardial effusions are common after cardiac surgery, clinically significant cardiac tamponade is rare in the absence of oral anticoagulants, cardiac catheterization, or pacemaker placement2. The incidence of pericardial effusion after valve repair is estimated to be 64%, whereas tamponade is seen in less than 1% of cases3. When tamponade is suspected, postoperative echocardiographic imaging is challenging due to altered anatomy and other post-surgical changes. It is important for anesthesiologists and intensivists to rapidly recognize and treat signs and symptoms consistent with cardiac tamponade.

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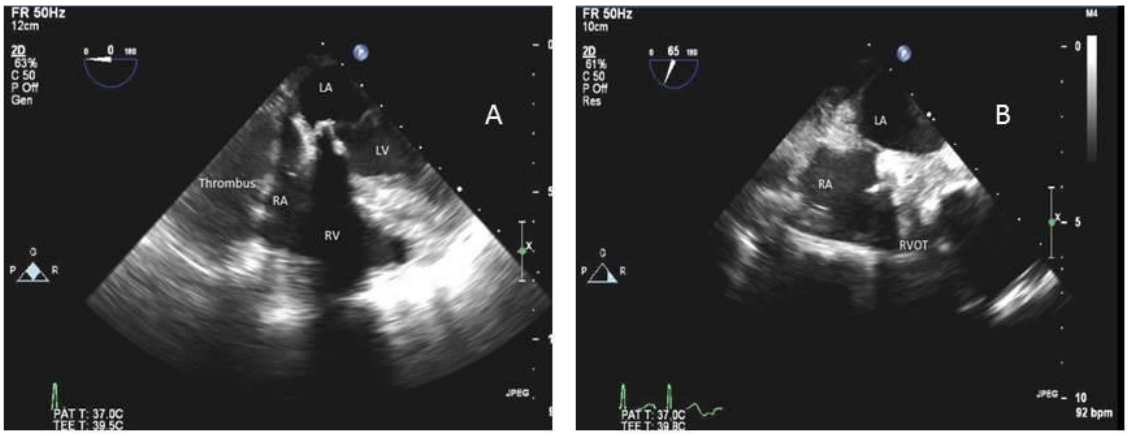


**Figure**. Intraoperative TEE showing RA compression due to a thrombus (Panel A) and return of RA cavity size after clot extraction (Panel B).

Poster 30

# Cardiac Tamponade and Ventricular Tear in a Patient With Myxedema Coma: Implications for Anesthetic and Perioperative Critical Care Management

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University of Miami, Leonard M. Miller School of Medicine[1]; Mount Sinai Medical Center[2]

**INTRODUCTION**: Myxedema coma (MC) is a rare and potentially fatal manifestation of severe hypothyroidism. MC rapidly progresses to multi-organ system failure making early recognition, diagnosis and treatment important for patient survival. The aim of this case presentation is to discuss the perioperative and critical care management of MC.

**CASE REPORT**: A 69-year-old woman with past medical history of hypertension presented with orthostatic symptoms for one month and a recent syncopal episode, complaining of dizziness, weakness, and lethargy. Physical exam revealed mild confusion, distant heart sounds, and facial/pedal edema. Significant laboratory findings included thyroid stimulating hormone >500 mIU/L (NL 0.358-3.74), total-T3 <10 ng/dL (NL 60-181), and free-T4 0.13ng/dL (NL 0.76-1.46). Thyroid replacement therapy (TRT) using intravenous Levothyroxine 100-150mcg daily and oral Liothyronine 5mcg three times daily was initiated.

On electrocardiogram, 1st degree A-V block with sinus bradycardia at 58bpm was noted. 2-D transthoracic echocardiogram demonstrated a large pericardial effusion with signs of cardiac tamponade. The patient underwent urgent pericardiocentesis complicated by ventricular tear requiring emergent surgical intervention. Sternotomy, evacuation of pericardial clot, and repair of the right ventricular laceration were performed uneventfully. Over two weeks, she continued on TRT with gradual normalization of thyroid studies and consistent clinical improvement.

**CONCLUSIONS**: MC is a potentially life-threatening endocrinologic emergency. As in our patient, MC can present with insidious symptoms. Pericardial or pleural effusions, macroglossia, non-pitting edema, goiter, hypothermia, hypotension, hypoglycemia, altered mental status and coma are associated findings of MC [1]. TRT must be initiated promptly. Patients who are elderly or have a cardiac history may warrant lower TRT dosing. Empiric glucocorticoid coverage for potential adrenal insufficiency is encouraged [2].

MC can be worsened by anesthesia and should ideally be treated prior to surgery. MC patients exhibit enhanced sensitivity to benzodiazepines and narcotics and require careful dosing, as they are prone to cardiovascular collapse and respiratory failure. Anticipation of a difficult airway is essential: airway edema and inflammation as well as thyroid enlargement may be present [3].

In summary, MC is a high acuity condition that must be rapidly detected and properly managed. Anesthesiologists, as perioperative physicians, must consider MC when evaluating patients both in the intensive care unit and operative setting to optimize patient outcomes.

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Poster 31

# Vicks VapoRub® Intoxication: An Unusual Presentation of Multiorgan Failure

Heather B Barkin M.D.; Ivet T Cordoba Torres M.D.; Jimena Marino-Nieto M.D.; Miguel A Cobas M.D., FCCM

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**INTRODUCTION**: Vicks VapoRub® is an over-the-counter cold remedy with cough suppressant and analgesic properties. This topically applied ointment contains synthetic camphor 4.8% [1]. Toxic camphor levels cause neurologic, gastrointestinal, hepatic, respiratory and cardiac compromise. Here we describe a patient with multiple comorbidities who presented with multiorgan failure after chronic Vicks VapoRub® ingestion.

**CASE REPORT**: A 54-year-old African American woman with a Heartmate II LVAD due to non-ischemic cardiomyopathy, atrial fibrillation, chronic kidney disease, hypothyroidism and asthma presented with acute onset of altered mental status (AMS), chest pain, shortness of breath and hypercapnic respiratory failure.

Upon ICU admission, the LVAD Pulse Index (PI) was low, and AICD interrogation revealed multiple episodes of ventricular tachycardia and fibrillation terminated by appropriately administered shocks. CXR showed mild pulmonary edema. Labs were significant for hypoxemia, metabolic acidosis (pH 7.12 Anion Gap 18), and elevated creatinine and liver enzymes. The clinical picture could not be explained by a single etiology and she was therefore treated symptomatically; fluid resuscitation and empiric antibiotics were started. Her low PI improved, but AMS, metabolic acidosis and acute-on-chronic kidney injury persisted.

Upon further investigation, we learned that the patient ingested three, 50g containers of Vicks VapoRub® weekly. Toxicology was consulted and a working diagnosis of camphor intoxication was made. It was speculated that her multiorgan failure could be best explained by acute on chronic camphor toxicity. Supportive measures continued, and over 2 weeks, mental status and laboratory abnormalities corrected to baseline. Lipid hemodialysis, while recommended for detoxification was not considered given the patient's gradual improvement [2].

**CONCLUSIONS**: Synthetic camphor is a primary, active ingredient of Vicks VapoRub® ointment. Acute camphor poisoning is predominantly seen in children; adults account for only ~10% of toxic exposures [3]. Consumption of 1g or 20mg/kg of camphor is considered highly toxic and our patient ingested roughly 5x this amount weekly [4]. Camphor toxicity affects all organ systems, causing seizures, altered mental status, dysrhythmias, myocarditis, mucosal irritation, nausea, vomiting, ventilatory failure and more. Treatment is largely supportive. Benzodiazepines are recommended for control of camphor related seizures. Ipecac induced emesis is discouraged. The utility of activated charcoal for detoxification is questionable [3,4].

This case demonstrates the misuse of over-the-counter remedies as a public health concern. Critical care physicians should be familiar with the presentation of camphor toxicity to enable early diagnosis and treatment. To our knowledge, this is the first report describing camphor toxicity in an adult secondary to Vicks VapoRub® ingestion.

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# PS01-06: MEDICALLY CHALLENGING CASES 2

## Posters: 32 - 37

**Moderator: Joseph A. Hyder, MD, PhD**

Poster 32

# Classic Triad: Pheochromocytoma, β-blocker, Hemodynamic Collapse

Sean Hynes MS4; Andrew Young M.D. PGY-4; Jill M Gelow M.D., M.P.H., F.A.C.C.; Daniel Sedehi M.D.

Oregon Health and Science University

A 34 year-old female with paroxysmal anxiety, headache, palpitations and hypertension presented to her local emergency room with a systolic blood pressure of 220mmHg. After initial treatment with intravenous labetalol and an esmolol infusion, she experienced hypotension and hypoxic respiratory distress due to acute pulmonary edema. Following endotracheal intubation, she developed ventricular fibrillation and underwent defibrillation with return of spontaneous circulation. She required high dose inotrope and vasopressor support. Right and left heart catheterization demonstrated normal coronary arteries, elevated right heart filling pressures and a left ventricular ejection fraction of 20%. An Intraaortic balloon pump (IABP) was placed, and she was transferred to a tertiary academic care center. Upon arrival she was sedated on fentanyl and propofol infusions. Her hemodynamics stabilized, vasoactive agents were weaned and her IABP was removed, but her troponin I was 70 ng/mL, her aspartate transaminase level was over 18,000 IU/L and her creatinine was 6.2 mg/dl indicating significant multiorgan dysfunction. Hemodialysis (HD) was initiated for hyperkalemia. Shortly after starting HD she became acutely hypotensive and was noted to have fixed and dilated pupils. Head CT demonstrated tonsillar herniation and global cerebral edema consistent with anoxic brain injury. Her family elected to pursue comfort care and she expired. Laboratory testing revealed 24-hour urine metanephrines of 13,500 mcg (normal range <400mcg). Autopsy found a 9cm x 6cm x 4cm pheochromocytoma in the right adrenal gland.

Pheochromocytoma is a rare neuroendocrine tumor often linked to multiple endocrine neoplasm (MEN) syndromes (1). These tumors arise from the adrenal medulla and produce elevated levels of catecholamines. Classically, catecholamine surge is associated with a paroxysmal triad of headache, tachycardia and diaphoresis (2). This patient experienced a hypertensive emergency, resulting in β-blocker induced cardiovascular collapse secondary to catecholamine surge with unopposed α-receptor stimulation. The harmful pharmacologic affect of β-blockade occurs in two ways – first by inhibiting intrinsic cardiac β-1 receptors responsible for inotropy, second through inhibition of the vasodilatory response from β-2 receptors on peripheral blood vessels (3). Thus β-blockers should be avoided in the acute hypertensive setting if there is any suspicion of pheochromocytoma. Labetalol has α and non-specific β adrenergic blocking properties and should only be administered after appropriate α-blockade is attained with agents such as doxazosin or prazosin. Additionally, calcium channel blockers may be utilized for additional vasodilation. Another key principle is removing the stressful stimulus precipitating the catecholamine release, such as pain or anxiety (4). Although rare, pheochromocytoma should be considered for any young person presenting with hypertension and symptoms of headache, palpitations, or diaphoresis.

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Poster 33

# Medically Challenging Case of Recurrent Glottic Edema Requiring Emergent Reintubation

David S Wang M.D.; Julia Sobol M.D.

Columbia University Medical Center

**INTRODUCTION**: We present a case of glottic edema noted after uneventful intubation which resolved upon repeat laryngoscopy, only to recur after extubation requiring emergent reintubation.

**CASE REPORT**: A 56-year-old woman presented for thyroidectomy and parathyroidectomy due to multinodular goiter and hyperparathyroidism. Her history included cerebral, opththalmic, and carotid artery aneurysms, status post multiple craniectomies and embolizations, hypertension, hyperlipidemia, and diabetes. She also had an extensive atopic history: hives to penicillin, Depo-Provera, Tegaderm; rash to latex; mouth numbness with Allegra. Her airway exam was reassuring.

Given the history of aneurysms, a pre-induction arterial line was placed for blood pressure monitoring. A C-Mac video laryngoscope was used to visualize placement of a nerve-monitoring endotracheal tube (ETT). The patient was induced with propofol and succinylcholine. Laryngoscopy showed a grade 1 view, and the ETT was placed atraumatically (Fig. 1). Dexamethasone was given for nausea prophylaxis. A shoulder roll was placed and propofol was given in anticipation of repeat laryngoscopy to confirm ETT position prior to the start of surgery. Unexpectedly, new edema of the vocal folds was noted (Fig. 2). No flushing was visible, and capnography revealed no bronchospasm. Additional dexamethasone was given for possible allergic reaction.

The surgery proceeded smoothly. At the end of the 1.5-hour case, propofol was given prior to repeat laryngoscopy to reevaluate glottic edema, with complete resolution (Fig. 3). The patient was extubated, but she exhibited audible upper airway stridor. The patient was then given albuterol, diphenhydramine, furosemide, and epinephrine for possible anaphylaxis. Approximately 20 minutes later, stridor was persistent and pulse oximetry had decreased to 89% on a non-rebreather, so she was induced again with propofol and succinylcholine. The patient was successfully reintubated; laryngoscopy revealed recurrent glottic edema (Fig. 4). She was transferred to the intensive care unit, where she remained on IV hydrocortisone and was extubated on postoperative day 1. Laboratory data, including serum tryptase, latex allergen, C1 esterase inhibitor, C4, and C1q binding assay, were all within normal limits. After resolution of persistent hypocalcemia, the patient was discharged home on postoperative day 8.

**CONCLUSIONS**: The differential diagnosis for the patient's airway edema included hereditary angioedema (HAE) and anaphylaxis. While HAE can involve the epiglottis (1), the lack of laboratory abnormalities makes this rare entity unlikely. Anaphylaxis/allergy is more likely, as laboratory testing has low sensitivity (2,3). Muscle relaxants such as succinylcholine are the most common drugs involved, although propofol, nickel, or silver remain possibilities (4).

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Figure 1: Representative image of airway on initial laryngoscopy

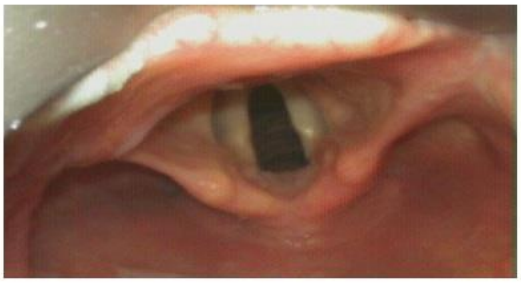
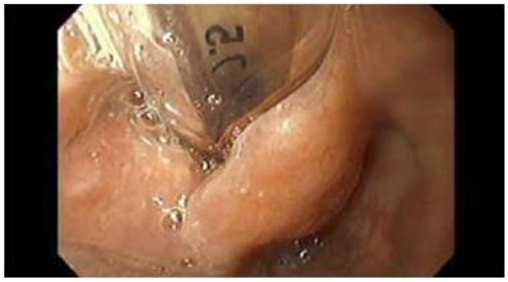


Figure 2: Representative image of glottic edema



Poster 34

# Severe Lactic Acidosis in a Liver Transplant Patient

Shweta R Yemul Golhar M.D., D.N.B.; Michael S Green D.O..; Stephen R Guy M.D., F.A.C.S.

Hahnemann University Hospital; Drexel University College of Medicine

**Introduction**: Post-transplant lymphoproliferative disorder (PTLD) is a grave complication of transplant. PTLD is characterized by B cell proliferation following T cell suppression. The UNOS database reports PTLD in 1.2% of organ-transplant recipients[1]. We report a case of fulminant PTLD with an ambiguous presentation.

**Case report**: A 68 year old male on immunosuppression for liver transplant 4 years prior, was admitted for diffuse abdominal pain. The abdomen ultrasound and LFTs were unremarkable. Over several days his pain worsened and the lactate levels rose. A CT scan showed diffuse bowel edema. Colonoscopy revealed erosions in the colonic mucosa, a biopsy showed ileitis. At laparoscopy the bowel and peritoneum were markedly edematous. Intraop the patient was acidotic (pH 7.08,LA-13) and hemodynamically very unstable. The lactate levels remained high despite fluid resuscitation. Post-op sodium bicarb infusion and CVVHD was initiated to manage the acidosis and electrolytes. Still the lactate level remained elevated. The differential diagnosis included acute liver rejection, sepsis, portal/mesenteric arterio-venous thrombosis. The patient deteriorated and was re-explored. At laparotomy there was diffuse thickening of all the bowel and peritoneum with discrete lesions. The surface was variegated and pebble like. A peritoneal biopsy showed lymphoma. Immunosuppression was held, chemotherapy was initiated however the patient deteriorated and care was withdrawn.

**Discussion**: In PTLD extranodal disease is more common hence presentation is often subtle and diagnosis delayed.[2] Mathur et al reported a renal transplant patient with early onset PTLD with very high lactic acidosis but associated with hepatic failure. The patient presented with nonspecific complaints. Reduction in immunosuppression and treatment with ganciclovir did not alter the course, the patient expired. High lactate levels did not respond to measures to improve perfusion, but unlike our case, hepatic failure prevented lactate clearance.
In our patient, there was no evidence of bowel ischemia, liver failure or rejection yet the lactates remained high. Laparoscopy revealed a peritoneal abnormality, biopsy of which lead to the diagnosis. Malignancies like acute leukemia/high grade lymphoma are associated with severe lactic acidosis, and generally have a poor prognosis. The elevated lactate level is due to the high metabolic rate of the lymphoma cells.

Nonspecific symptoms in PTLD can delay diagnosis where early cessation of immunosuppression and chemotherapy initiation can sometimes provide a cure.
This patient had negative diagnostic studies with persistent lactic acidosis. We conclude; transplant patients on immunosuppression presenting with high lactate levels without evidence of ischemia or liver failure should be closely evaluated for PTLD.

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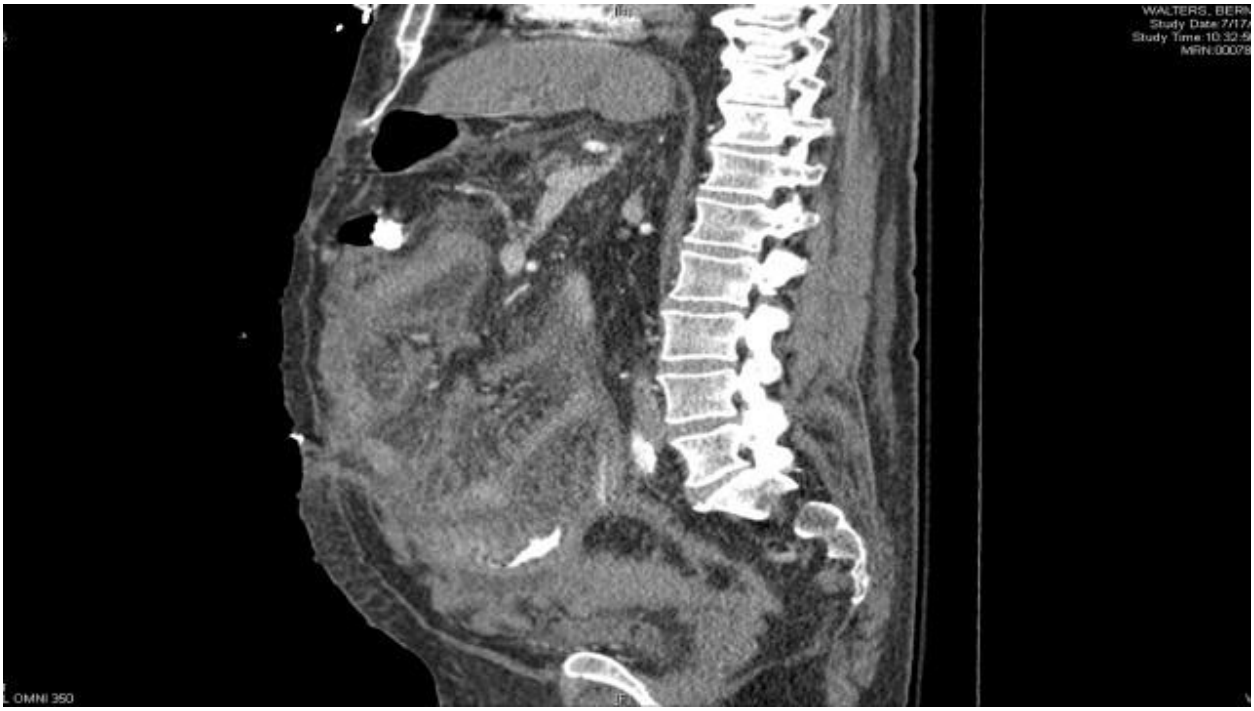


Poster 35

# V-V ECMO in the Treatment of Severe ARDS From Inhalant Abuse

Matthew C Hulse M.D.; Christopher P Henson D.O.

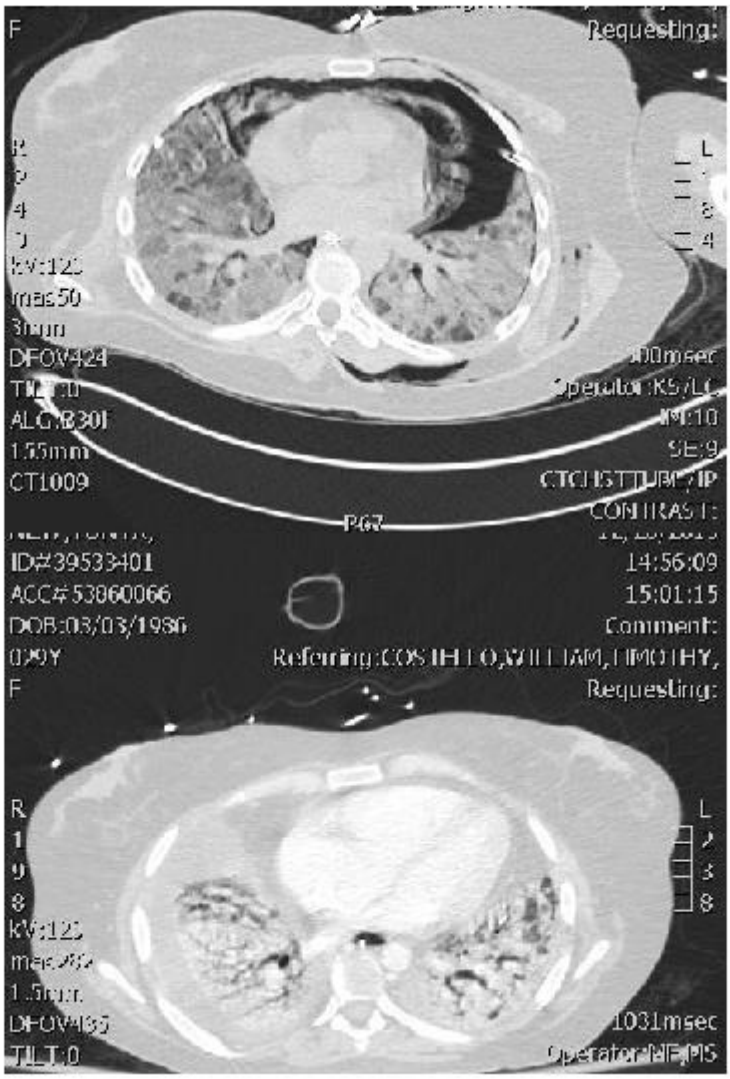
Vanderbilt University Medical Center

**Clinical Background**: Inhalant abuse is a major worldwide public health issue, associated with numerous acute and chronic medical problems. The popularity of electronic cigarettes and electronic nicotine dispensing systems (ENDS) is increasing rapidly in the United States, and several case reports have discussed the occurrence of severe pulmonary disease as a result of this resurgence in inhalant use. We report a case of acute inhalational injury from volatile organic substance abuse, unsuccessfully treated with venovenous extracorporeal membrane oxygenation (V-V ECMO).

**Case Presentation**: A 29 year old Caucasian female was transferred from an outside hospital for acute respiratory distress syndrome (ARDS) and hypoxic respiratory failure. The presentation to the outside facility was her third recent admission for complaint of productive cough, dyspnea, wheezing, and pleuritic chest pain. At the time of initial presentation, 7 days prior, her pulmonary imaging was normal and she was started on empiric antibiotics. On this presentation, new diffuse, bilateral infiltrates were seen on chest radiograph. This was concerning for an acute environmental or chemical exposure or a rapidly progressive inflammatory condition such as acute interstitial pneumonitis (AIP). Further medical history obtained from family revealed that the patient had recently attempted to stop smoking cigarettes following her initial admission. She attempted to use electronic vapor cigarettes as a smoking cessation aide; however, she experienced a severe reaction after the initial use, with multiple days of coughing and subjective choking to follow. Additionally, the patient had a previous history of inhalant abuse, specifically that of mothballs soaked in isopropyl alcohol.

Despite an exhaustive workup, including an open video-assisted thoracoscopic lung biopsy, the etiology of her pulmonary disease remained unclear. Her condition continued to worsen and she was subsequently transferred to our institution for increased level of care. She continued to deteriorate from severe, progressive, hypoxic respiratory failure despite maximal mechanical ventilator support and the decision was made to place the patient on V-V ECMO, accomplished with bedside cannulation using a dual-lumen right internal jugular catheter. The patient underwent a total of 70 days of ECMO support, had a near-complete recovery of all other organ systems, and was awake and ambulating. However, she had a poor degree of pulmonary recovery and could not be weaned from full ECMO support. The patient eventually succumbed to the cumulative effects of her co-morbidities after sustaining a large abdominal rectus sheath hematoma from spontaneous hemorrhage from the right inferior epigastric artery.

**Significance**: Volatile organic inhalant abuse continues to remain a public health problem, especially for the adolescent population. In addition to established risk from solvents with known abuse potential, the increased popularity of electronic nicotine delivery systems, especially those using various unregulated flavoring agents, creates the potential for a new constellation of lung injury. The critical care community will need to remain vigilant in the diagnosis and management of acute inhalational injury.




Pre-ECMO CT

ECMO Day 69

Poster 36

# Postoperative Management of a Single Lung Transplant Patient With Underlying Emphysematous Disease Using Independent Lung Ventilation

Ksenia Guvakova M.D.; Marshall Lee M.D.; Kathleen Tyson M.D.

Temple University Hospital

**Introduction**: Independent Lung Ventilation (ILV) is a tool used to achieve improved oxygenation in single-lung transplant (SLT) patients with Chronic Obstructive Pulmonary Disease (COPD) whose postoperative course is complicated by graft rejection or hyperinflation of the native emphysematous lung. There are limited studies discussing the uses and predictors of ILV. The purpose of this presentation is to investigate the utility of ILV in a SLT patient with known COPD. We will discuss the indications of ILV in the critical care setting and review literature that addresses ILV benefits and complication.

**Case**: A 66 year old woman with end stage lung disease secondary to COPD received a left SLT. Her postoperative course was complicated by under ventilation of the graft and hyperinflation of the native lung. A right-sided double lumen tube endotracheal tube (ETT) was placed on postoperative day one and asynchronous ILV initiated. ILV was maintained until postoperative day three. The patient continued to show signs of hypercapnic respiratory failure and left sided graft dysfunction and returned to conventional mode of ventilation.

**Discussion**: ILV can be established via a double lumen ETT or a single lumen ETT with a bronchial blocker. In physiological lung separation each lung is independently ventilated by separate ventilators. This is indicated in patients with asymmetric parenchymal lung disease with varying lung compliance and different airway resistance (1). ILV can be synchronous or asynchronous. The synchronous mode maintains an identical respiratory rate in both lungs and is achieved via one or two ventilators. Selective peep, tidal volumes and inspiratory flow rates are set independently. The asynchronous mode requires two ventilators that can be in or out of phase. Studies are limited, but have not shown any specific disadvantage in the use of asynchronous mode (1, 2). One retrospective study of patients who received SLTs over a period of 15 years determined a 12% requirement for ILV (3). It also suggested preoperative lung function tests showing low PaO2 to fractional inspired oxygen ratios (FiO2) are an indicator of early graft dysfunction (3,4,5).

**Conclusions**: ILV is a useful mode of rescue ventilation for SLT candidates in case of graft dysfunction and asymmetric lung disease. Research is limited, but predictors of ILV may be obtained from preoperative lung function tests. A postoperative management plan can be established based on PaO2/FiO2 ratio, underlying disease, and laterality of lung transplant.

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Poster 37

# Patient With Thoracic Spinal Cord Compression With a Confounding Presentation of Hypotension in a Poly-Shock State

Bhoumesh Patel M.D.; Dennis Warfield Jr. M.D.; Thomas Jan M.D., M.P.H.;
John Denny M.D.

Rutgers University, Robert Wood Johnson Medical School

**Introduction**: Thoracic spinal cord compression is often associated with motor and sensory deficits as well as autonomic dysfunction and is considered to be a neurosurgical emergency. When the lesion is above the T6 level, it may progress to neurogenic shock causing hypotension. Patients with this condition may develop other comorbidities if left untreated. We present a case report of a patient with a thoracic spinal cord compression from a tumor who presents to our institution with hypotension in the setting of a poly-shock state.

**Case Description**:
70 y/o F presented with new onset B/L lower extremity weakness progressing to paralysis who was found to have a T5-T6 intramedullary lesion with cord compression at T4 due to metastasis from a newly diagnosed malignancy (Figure 1). Decision was made to take the patient for emergent T5-T6 laminectomy. Preoperatively, the patient was hypotensive, unresponsive to IV fluids and was started on Norepinephrine and Epinephrine gtt. Intraoperatively, patient was found to have a neurogenic bladder with 1L of retained foul smelling urine, A dose of Levofloxacin was given and vasopressin gtt was started for continued hypotension. The procedure was completed without any complications. Post-op, patient remained intubated and was brought to SICU on multiple vasopressors. Urine cultures from the OR grew E. coli & K. pneumonia. Piperacillin-tazobactam was started and the patient was weaned off all vasopressors by hospital day 3. The patient subsequently was transferred out of the ICU.

**Discussion**: Shock is the state in which profound reduction of tissue perfusion leads to cellular injury hence it is always a life threating emergency. Diagnosis, evaluation, and management must occur rapidly in order to prevent irreversible damage. This is especially true in a sick patient where the cause may be multifactorial. In our case, the patient had hypotension in the setting of a thoracic spinal cord compression from a tumor that was severe enough to cause lower extremity paralysis. At first glance, neurogenic shock comes to mind in terms of cause of hypotension. However, the neurogenic bladder associated with it may have caused the patient to develop urosepsis. This may contribute to the hypotension and a poly-shock state. The causes of hypotension were promptly identified and treated with surgery, vasopressors, and antibiotics.

**Conclusion**: Thoracic spinal cord compression is a surgical emergency and may present with hypotension due to neurogenic shock. The etiology of hypotension may not necessarily be clear in these patients, especially when they are actively decompensating. It is essential to examine other etiologies of hypotension as there may be confounders, as seen in this patient. This patient had a neurogenic bladder leading to urosepsis and was found to be a major contributor to the poly-shock state.

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# PS01-07: MEDICALLY CHALLENGING CASES 3

## Posters: *38, 39 - 43

*Poster Withdrawn

**Moderator: Ronald G. Pearl, MD, PhD**

Poster 39

# Fatal Malignant Cerebral Edema After Cranioplasty

Niraj K Agarwalla D.O.; Elaine Kilmartin M.D.; Michael E. Mahla M.D.

Thomas Jefferson University Hospital

**Introduction**: Massive cerebral edema after cranioplasty has been rarely described in the surgical literature with few postulations of its etiology (1-8). All reported cases have resulted in patient mortality (1-8). This syndrome is insidious in its clinical course and difficult to diagnose. We describe a case of a young male who developed massive cerebral edema following a right-sided cranioplasty, ultimately leading to brain death. We also highlight the difficulty in recognizing this rare complication and present possible management strategies. There seems to be a need for further research in this area in order to understand the pathogenesis and generate effective management.

**Case Description**: A 37-year old male presented from his nursing facility for a right-sided cranioplasty with polyether ether ketone custom implant. Four months prior to his presentation for a cranioplasty, the patient underwent an urgent aortic valve replacement with a ventricular septal defect repair and aortic root debridement complicated by an ischemic stroke requiring a decompressive hemicraniectomy. A head CT prior to the cranioplasty showed right-sided encephalomalacia, a ventriculostomy catheter, and 7.4mm left midline shift (Figure 1). At the end of the cranioplasty surgery, the patient became hemodynamically unstable and gradually apneic. Head CT showed evolution of the right hemispheric infarction, extensive left-sided (contralateral) edema with a 23mm rightward midline shift, and extensive subcortical hypoattenuation compatible with hypoxic ischemic changes (Figure 2). After immediately returning to the OR for removal of the implant and left-sided decompressive craniectomy, a postoperative head CT suggested global ischemia with impending tonsillar herniation. With absent brainstem reflexes, the decision was ultimately made to withdraw care and the patient expired soon after.

**Discussion**: This case report presents the rare complication of massive cerebral edema following an otherwise uneventful anesthetic and surgical cranioplasty course. Given this patient's complex medical history, our differential diagnosis at the onset of his decreased blood pressure and increased heart rate was wide; it included pulmonary embolism, myocardial ischemia, stroke, and cerebellar herniation. Speculative etiologies for the massive edema that have been proposed include: impaired cerebral autoregulation of infarcted neural tissue (3,4,5,7,8), reperfusion injury(1), venous congestion(1,2), intraoperative cerebrovascular insufficiency (2), a ventriculo-peritoneal shunt association(4,7), and the effects of subgaleal suction drainage following cranioplasty on intracranial pressure dynamics(4,6,7,8). We believe that early recognition of this phenomenon by anesthesiologists, intensivists and surgeons, combined with timely surgical intervention, may alter the devastating outcome that seems to be the ultimate result of this complication.

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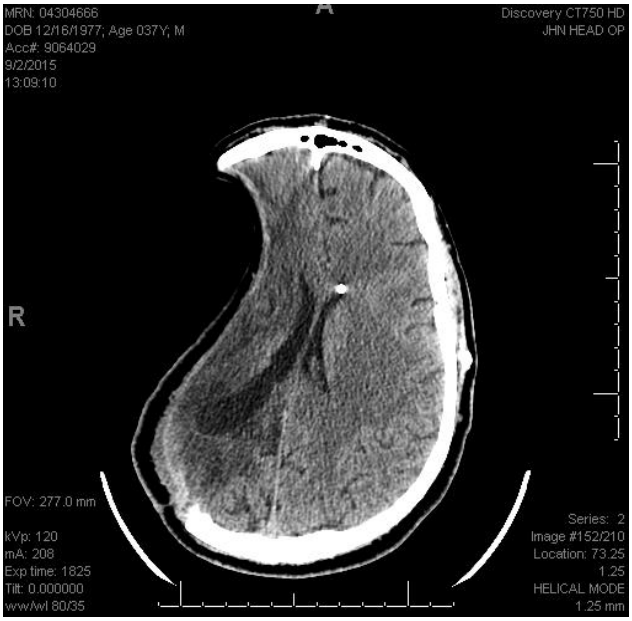


*Figure 1*

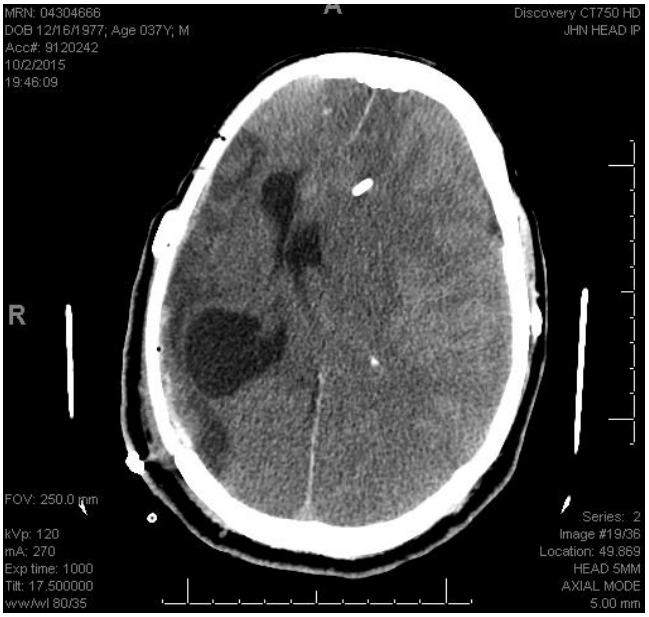


*Figure 2*

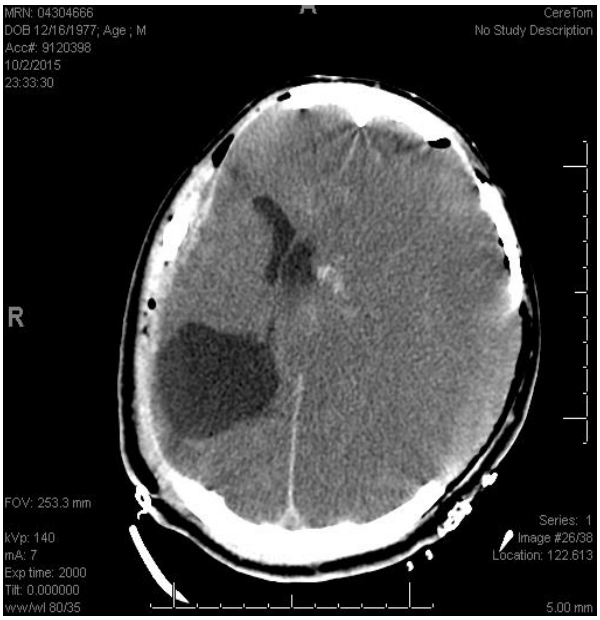


*Figure 3*

Poster 40

# Utilization of Extracorporeal Membrane Oxygenation in a Patient With Respiratory Failure Secondary to Undiagnosed Acquired Immune Deficiency Syndrome

Michael Kim D.O.; Antonio Conte M.D., M.B.A.; Danny Ramzy M.D.; Cyril Gaultier M.D.; Elizabeth Behringer M.D.

Cedars-Sinai Medical Center

**INTRODUCTION:** Extracorporeal membrane oxygenation (ECMO) is a proven therapy for respiratory failure due to multiple etiologies. ECMO is typically avoided in immune compromised patients due to concerns of further diminishing immune function. Despite these concerns, there are no absolute contraindications regarding the use of ECMO in patients infected with Human Immunodeficiency Virus (HIV) or with Acquired Immune Deficiency Syndrome (AIDS). Few cases of ECMO initiation in patients with HIV/AIDS have been reported.[1-3] This case report describes the utility of ECMO in a patient with respiratory failure and undiagnosed AIDS.

**CASE PRESENTATION:** The patient is a previously healthy 29 year-old male who presented with new onset shortness of breath associated with productive cough, headache, and body aches. Physical exam was remarkable for cachexia, diffuse crackles, oral thrush, pinkish papules on his knees and purple lesions on trunk and extremities. He was emergently admitted for possible pneumocystis jirovecii pneumonia (PJP) and acute respiratory distress syndrome (ARDS). Admission labs revealed a CD-4 T-cell count of 4 cells/ml3 and a positive HIV PCR test. He was emergently intubated and ARDS-net protocol initiated. Despite treatment with inhaled nitric oxide and positioning maneuvers, the patient's ARDS worsened. The patient required emergent veno-venous ECMO, via his Right Internal Jugular, due to persistent hypoxemia. The patient's ECMO course was complicated by delirium, correction of AvalnTM dual-cannula malpositions and a uvular laceration following TEE probe insertion requiring operative repair, Anti-HIV retroviral medications (emtricitabine, tenofovir and dolutegravir) were initiated with resultant decrease in HIV viral load. On post-ECMO day 19, the patient was successfully decannulated. The patient required prolonged ventilatory support, and tracheostomy placement. He was progressively weaned to trach collar. After 65 hospital days, the patient was discharged to a long-term assisted care facility. He remains on antiretrovirals with increases in CD-4 T-cell count and HIV viral load suppression.

**DISCUSSION:** This case report demonstrates the successful utilization of ECMO in a patient with ARDS secondary to undiagnosed AIDS. ECMO implementation resulted in gradual improvement in respiratory function while concomitant treatment for PJP and HIV infections were initiated with antimicrobials and HIV antiretrovirals. No evidence of immune reconstitution inflammatory syndrome (IRIS) occurred during the patient's hospitalization.[4] Typically, PJP is associated with IRIS, however, in our case the patient's cause for ARDS was a result of untreated HIV infection leading to AIDS. Due to almost two-decades long experience with HIV(+) patients undergoing cardiac surgery and improved HAART, early implementation of ECMO for respiratory failure combined with medical therapy may significantly impact

survival in patents with PJP secondary to AIDS. Centers experienced with management of HIV patients and ECMO should consider utilizing this modality in select patients.

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Poster 41

# Axillary Artery Cannulation During Veno-Arterial ECMO for Retrograde Cerebral Perfusion

Joshua Kohtz M.D.; James Osorio M.D.

New York Presbyterian Hospital - Weill Cornell Medical Center

**Background**: Similar to cardiopulmonary bypass, veno-arterial extracorporeal membrane oxygenation (VA-ECMO) can provide full circulatory and oxygenation support to the body. During VA-ECMO oxygenation occurs via an oxygenator supply source and a pump returns blood to the arterial system, providing circulatory support.

Neurological injury in patients treated with ECMO remains an ongoing area of investigation, with one study showing a 50% incidence of injury.

Case reports exist of using a second arterial cannula for perfusion of the extremity distal to the cannulation site. However, to the best of our knowledge no report has described using a second arterial cannulation to improve cerebral oxygenation via retrograde perfusion from the arterial circuit to the axillary artery.

**Case Report**: A 73 year old male with a history of biventricular heart failure, diabetes, hypertension, hyperlipidemia, and chronic atrial fibrillation underwent an elective mitral valve ring repair, tricuspid valve annuloplasty and two vessel coronary artery bypass grafting.

Postoperatively the patient was in cardiogenic shock from acute systolic and diastolic heart failure, requiring large volume resuscitation and catecholamine support. An intra-aortic balloon pump was placed on postoperative day 3.

The patient subsequently developed refractory hypoxemia and femoral-femoral VA-ECMO was initiated on postoperative day 5 with removal of the IABP. The patient was kept sedated and paralyzed, with no normal neurological exam since undergoing surgery. He was transferred to our facility for management of his persistent cardiogenic shock and acute respiratory distress syndrome.

The patient developed intrapulmonary hemorrhage requiring bronchial blockers and eventually total cessation of pulmonary ventilation. His course was further complicated by acute renal failure and hyperlactemia acidosis requiring hemodialysis.

To improve cerebral oxygenation a second arterial cannula (6 French) was placed from the ECMO circuit via bedside percutaneous technique into the right axillary artery. This was later upgraded surgically to a right-subclavian artery conduit catheterization.

Despite improvements in cardiac function, the patient developed pulmonary hemorrhage and was unable to wean from ECMO. Ultimately the patient remained comatose and was pronounced brain dead after prolonged cessation from sedation.

**Discussion**: This complex case presented multiple medical and ethical challenges requiring the coordination and multidisciplinary effort of many teams.

The bedside insertion of a percutaneous catheter for retrograde perfusion to maintain adequate cerebral oxygenation might prove a valuable tool for reducing neurological injury during ECMO.

Objective measurement of improved cerebral oxygenation via invasive or non-invasive monitoring should be employed. Additionally, angiographic studies could be used to determine enhancement of cerebral perfusion with the addition of a proximal cannulation site.

Given the expanding role of ECMO and the ethical concerns of its use in patients with limited or no informed consent because of the emergent nature, it remains the responsibility of the healthcare team to treat the patient to the best of his wishes as they are known or expressed through a proxy.

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Poster 42

# Overheating of a Rapid Infuser During Massive Tranfusion

Natalie A Ferrero M.D.; Babar Fiza M.D.; Neal Duggal M.D.

University of Michigan

**Introduction**: Hemorrhagic shock is one of the leading causes of mortality in the operating room. The treatment of patients with hemorrhagic shock frequently requires massive transfusion, which often necessitates the use of rapid infuser devices. These devices enable high-volumes of blood products to be administered quickly, and also warm the infusate to prevent transfusion related hypothermia. Our institution utilizes the FMS 2000 Rapid Infuser (Belmont Instrument Corporation, Billerica, MA) for this purpose. In this report, we present a case of overheating and rupture of the rapid infuser disposable unit during massive transfusion.

**Case**: A 49-year-old female with cirrhosis due to autoimmune hepatitis was brought to the post-anesthesia care unit (PACU) after a transjugular intrahepatic porto-systemic shunt (TIPS) procedure. The patient became increasingly hypotensive. A blood gas obtained was remarkable for hemoglobin < 4 and lactate >15. A femoral 9Fr multilumen access catheter was placed and transfusion of packed red blood cells (pRBC) was initiated using a rapid infuser. The patient was brought to the interventional radiology (IR) suite for treatment of the bleed. A drain was placed to decompress the abdominal cavity and six liters of accumulated blood was immediately evacuated. Resuscitation with pRBC and fresh frozen plasma (FFP) through the rapid infuser continued. A smell of burning plastic was soon noted, as disposable tubing within the rapid infuser began to melt and rupture. This was followed by an overheat alarm from the rapid infuser and its self-programmed shut-down. Hemodynamic collapse immediately ensued. The cardiac rhythm degenerated to ventricular tachycardia. Chest compressions and epinephrine boluses were administered per ACLS protocol. Massive transfusion was resumed with an alternate rapid infuser. Spontaneous circulation returned after two minutes. The patient then developed overt pulmonary edema with worsening hypoxia and hypercarbia. The surgical service controlled the source of the bleed and massive transfusion gradually seceded. However, the pulmonary edema progressed and eventually precluded the ability to oxygenate or ventilate.

**Discussion**: Previous reports of rapid infuser overheating have been hypothesized to occur as a result of clot formation in the tubing due to administration of pro-coagulant solutions through the infuser (1). In this case, pro-coagulant products were administered through dedicated intravenous lines in the upper extremity, sufficiently distanced from the Belmont's femoral access to be considered a contributing factor. The overheating of our rapid infuser was due to intrinsic device malfunction, a rare but potentially devastating complication that must be kept in mind when utilizing rapid infusers.

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Poster 43

# Difficult Airway Management in a Patient Undergoing Resection of a Pheochromocytoma

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University of Michigan Health System

**Introduction**: Perioperative hemodynamic management of a patient undergoing resection of a pheochromocytoma can be challenging[1], and complicating the issue with factors suggesting a difficult airway can make this task even harder. As the combination of these elements makes for a rare event, we describe a case involving a patient with a pheochromocytoma that needed an awake fiberoptic intubation (AFOI) to undergo his surgical resection.

**Case Report:** A 76-year-old ASA class III male presented for a laparoscopic aderenalectomy for a pheochromocytoma. He had been medically managed with nicardipine for three weeks. His airway exam was notable for a Mallampati III classification, limited neck extension and rotation from a previous C1-C3 vertebral spinal fusion, and limited jaw protrusion. Given this, the decision was made for an elective AFOI. Typically, our institution employs low dose remifentanil as a sedative during an AFOI; however, we felt our circumstances called for the utilization of dexmedetomidine. In preoperative holding, his blood pressure was 144/70 with a heart rate of 67. Glycopyrrolate 0.6 mg was given as an anti-sialagogue with 40 mg esmolol to control his heart rate. Nineteen minutes later, a loading dose of dexmedetomidine 90 mcg (1 mcg/kg) was given over 10 minutes and an infusion was started at 1 mcg/kg/hr. Blood pressure and heart rate remained stable at 140-150/50-60 and 60-65 respectively. We were successfully able to use dexmedetomidine to maintain steady hemodynamic parameters during the AFOI and the majority of our case.

**Conclusions**: The major concern in our unique situation was that the use of glycopyrrolate preoperatively combined with prolonged stimulation of an AFOI would evoke an intense sympathetic response that may result in uncontrolled hypertension both pre- and intraopertively. Animal studies have shown that the strong selective alpha-2 blockade by dexmedetomidine helps reduce the release of endogenous catecholamines, creating a sympatholytic effect[2], a desirable effect in a patient with a pheochromocytoma. The anti-sialagogue properties of dexmedetomidine allowed us to use a lower dose of glycopyrrolate to achieve optimal conditions for the AFOI. Thus, a combination of these desirable effects of dexmedetomidine resulted in maintenance of stable hemodynamics in our patient. There have been case reports of the use of dexmedetomidine intraoperativley for pheochromocytoma resections; however, its use for an AFOI in this patient population is yet to be described[3]. Our case provided a challenging and rare situation in regards to anesthetic management with successful use of dexmedetomidine in the perioperative period.

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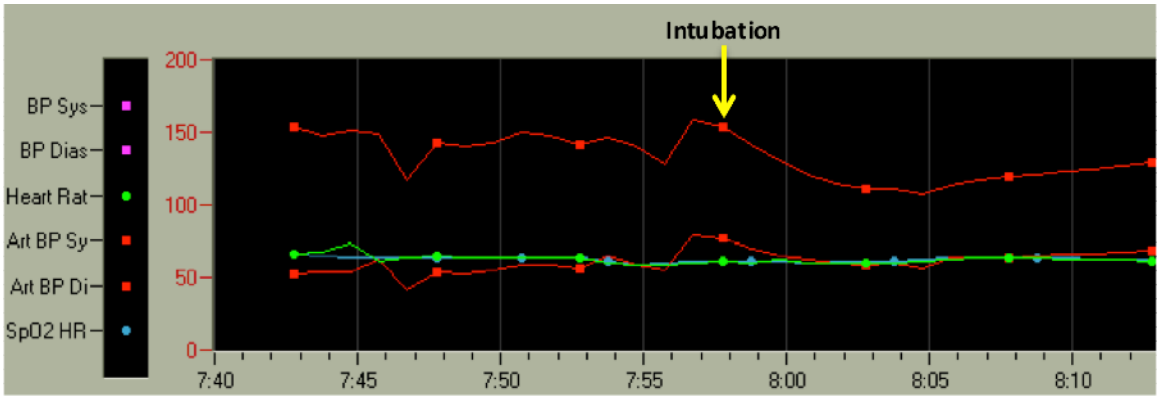

# PS01-08: ECONOMICS, EDUCATION AND POLICY & LIVER & PATIENT SAFETY

## Posters: 44 – 50, *51

*Poster Withdrawn

**Moderator: Nicholas Sadovnikoff, MD, FCCM**

Poster 44

# Addition of Focused Critical Care Transthoracic Echocardiography (FoTE) Learning into an Existing Anesthesiology Residency Training Program: A Prospective Study of Blended Learning

Tanya M Richvalsky D.O.; Nibras Bughrara M.D.; Victoria Sokoliuk D.O.; Kevin Roberts M.D.

Albany Medical Center

**Introduction**: Blended or mixed-mode class learning incorporates a portion of educational processes from Web Based sources into an educational initiative. We sought to discover whether competency in acquisition and interpretation of Focused critical care Transthoracic Echocardiography (FoTE) could be achieved by the addition of blended learning to an existing anesthesiology-residency training program. Bedside FoTE starts with a specific question, which requires immediate interpretation and clinical decision-making in the rapidly deteriorating patient (1). Repeated bedside FoTE can be performed to assess the changing status and to modulate treatment accordingly (2,3). The principal goal of this study is to quantify the improvement that anesthesiology residents can achieve in a standardized FoTE exam after a one-day training course.

**Methods**: A prospective analysis of educational data at a large academic medical center was undertaken. Our methodology is an adapted version from a study previously described (4). A total of 22 anesthesia residents took a standardized pre-test created by the Society of Critical Care Medicine (SCCM) for their basic FoTE course. The test included identification and acquisition of standard transthoracic views, recognition of cardiac structures and interpretation of images from presented clinical cases. All participants completed a one-day training course (four hours web based FoTE video lectures). This was followed by four hours of hands-on FoTE training, moderated by a critical care certified anesthesiologist with expertise in advanced Critical Care Echo.
At the end of the course, all participants repeated the test. The pretest and posttest scores for each participant were compared for improvement. The difference of the scores after training was calculated using the t-test with significance defined as $p<0.05$.

**Results**: Twenty-two anesthesia residents completed the one-day FoTE course. All of them performed the SCCM standardized pre and post-test and showed improvement of mean scores of 14.5±2.8 (48%) to 18.3±3.2 (61%), ($p=0.000002$).

**Conclusion**: FoTE training can be a critical and useful modality in diagnosis of shock and acute respiratory insufficiency in the perioperative and critical care setting and should be incorporated as a core competency of anesthesia providers. Although a one-day training course improved resident knowledge in FoTE, it was not enough to achieve competency (defined as score of 80%). We are currently testing if CA-2 residents can achieve competency by 1-week intensive training. A portion of this

educational initiative is the SCCM web based FoTE video lectures (total of 8 hours) which has decreased the number of faculty involved in training. The hands-on portion includes practice with Heartworks® simulator followed by at least 30 supervised FoTE studies performed in patients in PACU, POCU and SICU under direct supervision of an advanced FoTE-trained Critical Care Anesthesiologist.

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Poster 45

# The Impact of a Perceptual and Adaptive Learning Module on Transesophageal Echocardiography Interpretation in Anesthesiology Residents

Brian T. Romito M.D.[1]; Sally Krasne Ph.D.[2]; Anahat Dhillon M.D.[2]

University of Texas Southwestern Medical Center[1]; David Geffen School of Medicine at UCLA[2]

**Introduction**: Transesophageal echocardiography (TEE) has been an integral tool in the anesthetic management of cardiac surgical patients, and its utility in other settings is becoming realized. Despite the growing applicability of TEE in anesthesiology, formal TEE education is lacking from many training programs. Perceptual and adaptive learning modules (PALMs) are tools that have been created to enhance pattern recognition. (1) Recently-published studies have described the impact of PALMs in teaching histology and dermatology lesion description to medical students. (2,3) In the present study we evaluate the effect of TEE PALM training on the accuracy and response times (RT) in diagnosing TEE cardiac pathology in PGY-1 anesthesiology residents versus PGY-1 anesthesiology residents receiving no PALM training.

**Methods**: We developed a PALM that displayed cardiac diagnoses in video loops as viewed via TEE. The TEE PALM asked subjects to identify images according to six diagnosis categories. The PALM and associated tests were built from videos recorded from intraoperative TEE examinations. 24 residents were randomly assigned to a control group (n=12) or an experimental group (n=12) that used the TEE PALM. Both groups received a lecture showing an example video clip of each of the diagnoses in the PALM. Both groups then received a TEE pre-test that measured their accuracy and RT. The experimental group completed the TEE PALM and was given a post-test after 30 minutes and a delayed test approximately six months later. The control group received a delayed test approximately six months after their pre-test. Comparison data was also collected for CA-1 and CA-2 residents, cardiac anesthesiology faculty, and MS4s. Two outcomes were measured: accuracy (the percent of correct responses) and fluency (the percent of responses that were both accurate and within the target RT).

**Results**: The experimental group who completed the TEE PALM had significant improvements in both accuracy and fluency ($p<0.0001$), and these improvements exhibited large effect sizes: $d=5.4$ for accuracy and $d=4.3$ for fluency. After approximately six months, the experimental group's performance remained significantly higher than their pre-test values for both accuracy ($p=0.0002$, $d=2.7$) and fluency ($p<0.0001$, $d=2.3$). Six months following completion of the TEE PALM, the experimental group had scores similar to those of cardiac anesthesiology faculty physicians (Figure 1) for both accuracy ($p=0.31$) and fluency ($p=0.72$).

**Conclusions**: The current study demonstrates that brief exposure to a PALM significantly improved the accuracy and RTs in diagnosing TEE cardiac pathology in a group of anesthesiology residents. The results of this study provide further evidence that PALMs can significantly improve learning and pattern

recognition in medical education and should be adopted into a standard curriculum.

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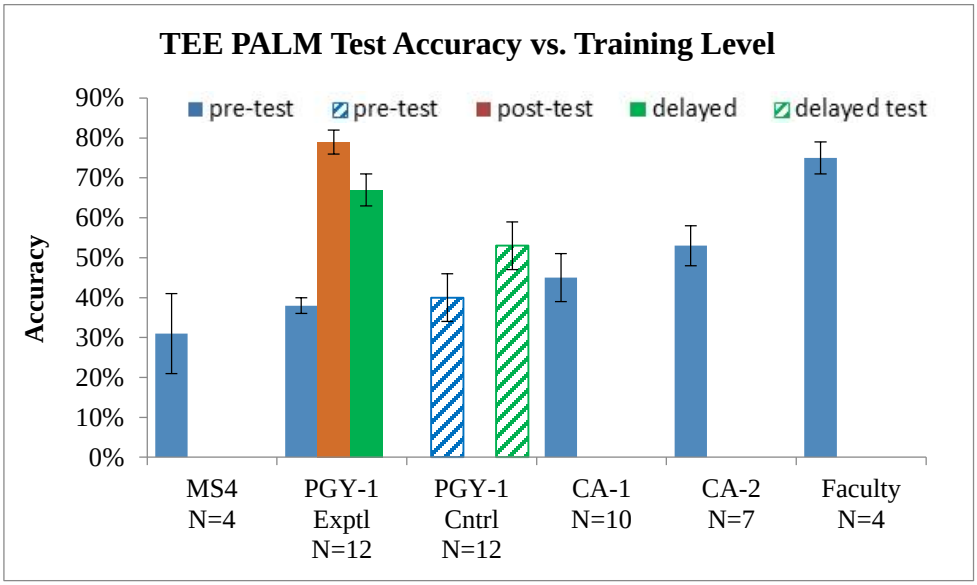
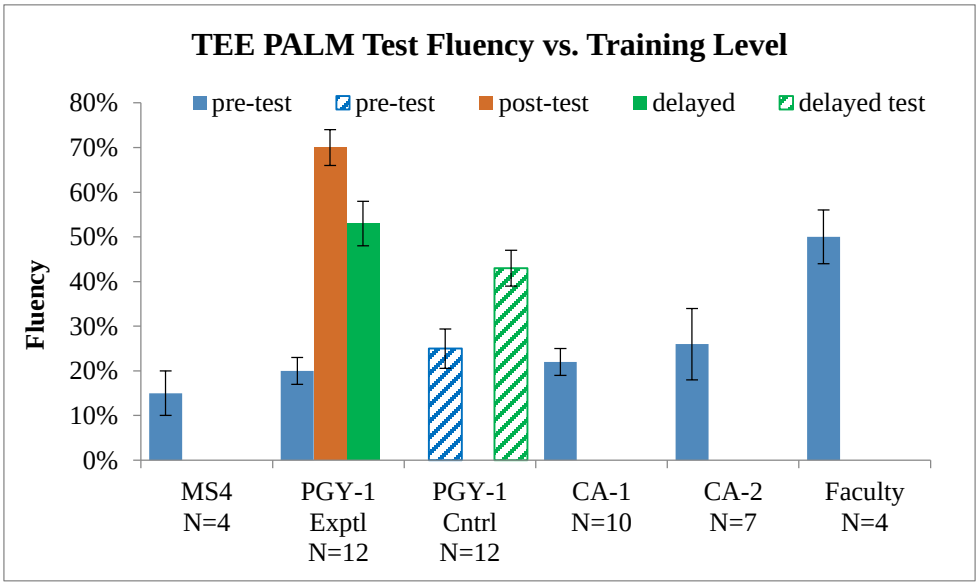



**Figure 1.** TEE interpretation accuracy (top) and fluency (bottom) at different levels of training.



Poster 46

# Analysis of Admission/Discharge Criteria Adherence Among Closed and Open ICUs on Weekends vs. Weekdays

Lucas Sittner D.O.; James Walker M.D.; Serkan Toy Ph.D.; Hai Nguyen D.O.; David Hollenbeck, Medical Student

The University of Kansas

**Introduction**: Intensive Care Units in the United States consume up to 10% of all hospital beds, utilize up to one third of hospital resources, and generate 1% of the gross domestic product or almost $64 billion each year.1 The growing demand for critical care beds is demonstrated by the 50,000 – 100,000 patients that hold ICU beds on any given day in the US.1 The goal of this study is to assess how strictly ICU admission criteria are followed in closed ICUs versus open ICUs. Hypothesis: Unwarranted ICU bed occupancy rates will be higher in the open unit and higher on weekends for both units.

**Methods**: This retrospective observational study incorporated the review of medical records of consecutive patients ages 18 and older located in the closed Neurocritical Care Unit (NCCU) and open Medical Intensive Care Unit (MICU). Medical records came from four random weekdays and two random weekends between July 1, 2015 and July 31, 2015. Nationally recognized criteria set by the Society of Critical Care Medicine2 were applied to patients located in these ICU's by two researchers and the results were cross-analyzed by the third researcher. Consensus categorizations of the three researchers were used in the analysis. A set of chi-square tests was used to test the hypothesis. Included cases provided >80% power for a chi square test of 2×2 contingency tables with medium effect size (0.3).

**Results**: A total of 202 patient charts were reviewed (118 MICU and 84 NCCU). For MICU, unwarranted bed occupancy was found to be 43% on weekdays (36/84), 41% on weekends (14/34), and 42% overall (50/118). For NCCU, unwarranted bed occupancy was 20% on weekdays (11/54), 27% on weekends (8/30), and 23% overall (19/84). A chi-square test of independence was performed to examine the relation between the type of ICU (MICU vs. NCCU) and number of unwarranted beds occupied overall. The relationship between these variables was significant, $X2$ (2, N = 202) = 8.51, p = .004. Results also indicated significantly higher unwarranted bed occupancy during the weekdays for MICU compared to NCCU, $X2$ (2, N = 138) = 7.40, p = .007. Within each ICU types, weekend vs. weekday bed occupancies were not significantly different.

**Conclusions**: Overall and weekday unwarranted bed occupancy was significantly higher for the open ICU. This data suggests that ICU admission/discharge criteria are more strictly adhered to by closed intensive care units on weekdays. Reasons for unwarranted ICU bed occupancy need further exploration given the potential impact on patient care and cost to hospitals and patients.

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Poster 47

# An Algorithm to Teach the Concept of a Just Culture as a Foundation for Patient Safety

Theresa Northern D.O., M.P.H.; Philip Boysen M.D., M.B.A.; Jeffrey Cardinale M.D.

Ochsner Health System

**Introduction**: Each year the ACGME surveys residents and fellows as a means of assessing the learning environment for the Sponsoring Institution, The survey data are taken into account for the accreditation of component programs, and the Sponsoring Institution as an entity. Aggregate data may be used to develop or change policy and improve the quality of programs that function within the guidelines approved by the ACGME, and the Residency Review Committees for individual specialties. The anonymous survey includes six content areas 1.) duty hours, 2.) faculty scholarship and supervision, 3.) adequate feedback and evaluations, 4.) educational content, 5.) resources, 6.) patient safety and teamwork. Two of these domains directly relate to the presence or absence of a just culture. In presenting an orientation curriculum to onboarding residents, we identified a knowledge deficit in graduating medical students, and developed an algorithm to demonstrate the concept using scenarios of behavior.

**Materials and Methods**: We used the following definitions:

Just Culture: Individuals are responsible and accountable for their behaviors, but blameless in the event of human error. Incidents and near misses are reported without fear of reprisal.

Human Error: Unintentional and unpredictable outcomes while following accepted guidelines and procedure.

At Risk Behavior: Unsafe habits due to a behavioral choice that increases risk where risk is either not recognized or mistakenly believed to be justified.

Reckless Behavior: Deliberate and conscious behavior in which the individual understands the risk and disregards policies or procedures.

Malevolent Behavior: A situation in which an individual INTENTIONALLY CAUSED HARM to another person.

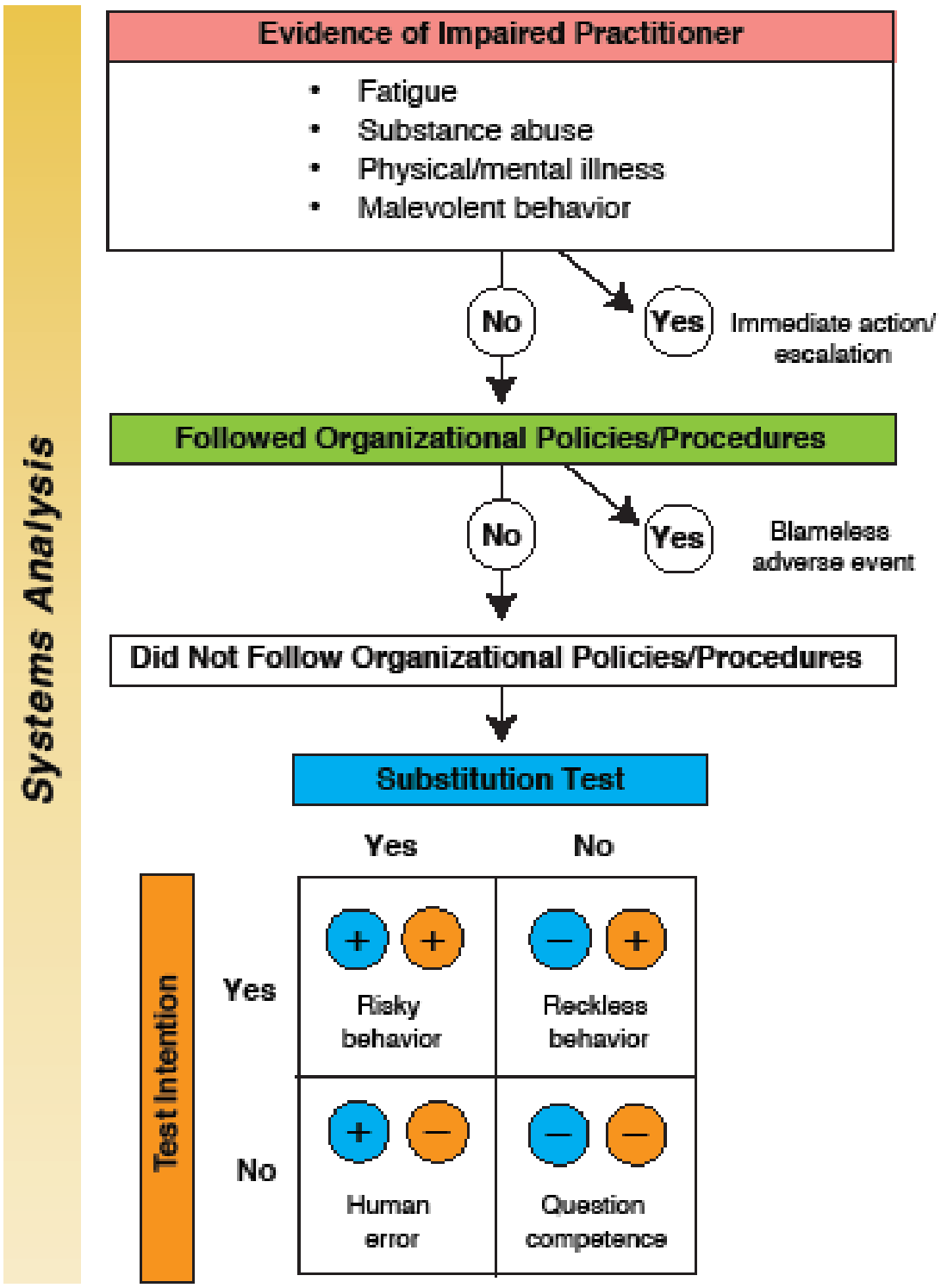
Normalization of Deviance: Deviation from a policy or procedure without an untoward consequence which reinforces continued deviance until it is accepted as "normal".

**Results**: We worked with 96 onboarding residents to use our algorithm to identify human error vs.

behavioral choice, and present options for remediation. Working in small groups all residents accomplished the task of analyzing five scenarios in less than an hour.

**Discussion**: A just culture is foundational to implementing patient safety. We describe a method of introducing the concept to incoming residents to raise awareness and develop assessment skills.

## Just Culture Algorithm



Poster 48

# The Systemic-to-Pulmonary Artery Pressure Ratio as a Predicator of Patient Outcome Following Liver Transplantation

Brooke Bauer M.D.; Annette Rebel M.D.; Nguyen Dung M.D.; Paul Sloan M.D.; Zaki Hassan M.B.B.A.

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**Background**: Outcomes following orthotopic liver transplant (OLT) are dependent on the ability of the patient's cardiovascular system to compensate for the physiological stress related to OLT. Right heart function appears to be a better predictor of survival after OLT than left ventricular function (LHF).1 While the preoperative assessment usually focuses on the LHF, the contribution of the right ventricle is less commonly evaluated. However, the mean systemic-to-pulmonary artery pressure ratio (MAP/mPAP) has been shown to be a valuable predictor of outcomes following cardiac surgery.2 The MAP/mPAP ratio as a predictor of patient outcome following OLT has not been investigated. Therefore the aim of this study was to assess the value of the MAP/mPAP ratio for predicting outcomes following OLT.

**Methods**: After IRB approval, a retrospective data analysis was performed on OLT patients at a single University Hospital during a thirty-six month period. The following intraoperative data was collected: mean arterial blood pressure (MAP), mean pulmonary artery pressure (mPAP) and Cardiac Index (CI). These hemodynamic parameters were collected at several points during OLT: Baseline (A1, 30min after incision), preanhepatic (A2, 1hr before IVC cross clamp), anhepatic (A3, 15min before reperfusion), neohepatic (A4, 15min after reperfusion), and 1hr neohepatic (A5, 1hr after reperfusion). Outcomes evaluated were extubation time (ET; minutes after ICU arrival), length of ICU stay (LOS ICU) and total hospitalization (LOS Total). Statistical analysis was performed using a paired t-test (significance $p<0.05$).

**Results**: A total of 100 patients were identified. Nine patients were excluded due to incomplete data collection. Based on the intraoperative course of the MAP/mPAP ratio, 2 hemodynamic responses were identified: Group 1 (MAP/mPAP ratio increase during anhepatic period with postreperfusion recovery, N=66); and Group 2 (MAP/mPAP with no change during anhepatic period or decreased without recovery, N=25). Surgery duration and intraoperative fluids were not different between the 2 groups. Group 1 ET, LOS ICU and LOS Total were significantly shorter than for Group 2 (Table 1). CI changes did not correlate with the MAP/mPAP ratio.

**Conclusions**: 1) The intraoperative pattern of MAP/mPAP ratio during OLT appears to be predictive of patient clinical outcomes. 2) Patients with an increased MAP/mPAP ratio during the anhepatic and neohepatic phases had an ICU stay 1/3 length of those who had no change or decreased MAP/mPAP. 3) An increased MAP/mPAP ratio during the anhepatic and neohepatic phases of OLT was associated with shorter ET and 2 week shorter LOS total. 4) Additional prospective studies are needed for more comprehensive risk stratification to explore the predictive value of this hemodynamic parameter.

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Table 1

| | Group 1 anhepatic increase of MAP/mPAP ratio with postreperfusion recovery N=66 | Group 2 no change or decrease of MAP/mPAP ratio during anhepatic/post reperfusion N=25 | P-Value |
|---|---|---|---|
| MAP/mPAP baseline | 3.32 ± 0.73 | 4.13 ± 1.19 | 0.19 |
| % change preanhepatic | 0.28 ± 1.28 | 0.18 ± 1.27 | 0.75 |
| % change anhepatic | 2.89 ± 1.83 | -0.09 ± 1.14 | *<0.01 |
| % change neohepatic | 0.21 ± 1.41 | -0.69 ± 1.33 | *<0.01 |
| % change 1hr neohepatic | 0.10 ± 0.83 | -0.61 ± 1.37 | *<0.01 |
| CI baseline | 4.11 ± 1.23 | 4.21 ± 0.96 | 0.88 |
| % change preanhepatic | 0.04 ± 0.79 | -0.20 ± 0.83 | 0.20 |
| % change anhepatic | -1.61 ± 1.02 | -1.19 ± 1.08 | 0.09 |
| % change neohepatic | -0.33 ± 1.32 | -0.06 ± 1.23 | 0.38 |
| % change 1hr neohepatic | 0.34 ± 1.11 | 0.45 ± 1.04 | 0.64 |
| | | | |
| Surgery duration [min] | 400.9 ± 43.5 | 427.9 ± 63.3 | 0.08 |
| Crystalloid given [ml] | 5804 ± 2824 | 6086 ± 3424 | 0.69 |
| Colloid given [ml] | 1440 ± 972 | 1607 ± 626 | 0.43 |
| PRBC given [units] | 3.3 ± 3.7 | 3.9 ± 3.1 | 0.47 |
| FFP given [units] | 2.8 ± 3.0 | 4.0 ± 4.6 | 0.15 |
| | | | |
| Time to extubation [min] | 967 ± 1361 | 1719 ± 1933 | *** 0.04** |
| [hrs] | 16.1 ± 22.7 | 28.7 ± 32.2 | |
| LOS ICU [days] | 3.9 ± 4.4 | 12.1 ± 19.2 | *** <0.01** |
| Median [days] | 2 | 6 | |
| LOS hospital [days] | 12.0 ± 12.5 | 26.3 ± 33.2 | *** <0.01** |
| Median [days] | 8 | 11 | |

MAP/mPAP = Mean Systemic-to-Pulmonary Artery Pressure Ratio, CI = Cardiac Index, Surgery duration = anesthesia time from induction to ICU transfer, Crystalloid = amount of intraoperative normal saline, Colloid = amount of intraoperative 5% Albumin, PRBC = packed red blood concentrate, FFP = Fresh frozen plasma, Extubation time = min from ICU arrival to extubation to supplemental oxygen, LOS ICU = length of stay in intensive care unit, LOS total = time from ICU arrival to hospital discharge.

Data are shown as mean ± SD. P value was obtained using paired t-test. * p<0.05

Poster 49

# Pneumothorax Associated With Misplacement of Small Bore Feeding Tubes

Jeffrey Cardinale M.D.; Philip G Boysen M.D., M.B.A

Ochsner Clinic Foundation

**INTRODUCTION AND GENERAL PURPOSE OF STUDY:** Within a short time span complications occurred during attempted blind placement of a small bore nasoduodenal feeding tube in patients located in high acuity care units. All of the patients suffered acute cardiac and respiratory decompensation. Under the auspices of the Ochsner Patient Safety Executive Council (PSEC) we were tasked with performing a Root Cause Analysis to determine root cause and probable and contributing factors involved in the complications in these patients. (1)

**METHODS:** The Ochsner Main Campus (OMC) facility formed the PSEC 5 years ago. In conjunction with the Hospital Performance Improvement group PSEC reviews reports of complications and near misses on our patients. The PSEC follows the recommendations of the National Patient Safety Foundation (NPSF) in their published document. (1) Following the Safety Assessment Code (SAC) matrix, it categorizes severity, extent of injury, length of stay, level of care required for remedy, and actual or estimated physical plant costs. Using the matrix patients are placed into one of four quadrants and classified as catastrophic, major, moderate, or minor events. These events were classified by the Council as catastrophic; we immediately began the investigation and analysis, including developing an Action Hierarchy as described in RCA squared.

**RESULTS:** Review of patient data are presented in Table 1. There were 3 males and 3 females, and 4/6 patients were >80 years of age. Multiple patient care sites experienced the complication: CMICU 3, SICU 2, the NeuroICU 1. All 6 of the patients had acute on chronic diagnoses with multiple co-morbidities. None of the patients were intubated and ventilated at the time the complication occurred. The pneumothoraces were equally divided between right and left side. The primary response to the acute event was chest insertion of a small bore pigtail catheter using a Seldinger technique. During resuscitative efforts all 6 patients were intubated, mean duration 38 hours. One patient expired. We performed a cost analysis of care for the complication estimated ~$18,000. Catheter insertion was by RN's.

**CONCLUSION:** With the timely acquisition of data we forwarded a recommendation to publish a moratorium on insertion of small bore feeding tubes while we performed a second set of analyses on policies, procedures, education and competence of providers, indication for post pyloric feeding tubes vs. gastric feeding tubes, and reviewed new technology for placement.

**DISCUSSION:** A systematic review of enteral feeding tubes did not favor using small bore feeding tubes versus gastric tubes. (2) However a recent meta-analysis suggested a decreased incidence of pneumonia with the post-pyloric approach. Further, recent development of tube placement using an

electromagnetic device purports to increase accuracy of placement, and reduce costs associated with radiographic confirmation of placement. (3) A major issue in all reports is moving towards a small group of providers placing these tubes while monitoring education and competence.

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| Age | Sex | Hospital Service | Final Diagnosis | Time to Diagnosis | Treatment | Pnemothorax (Side) |
|---|---|---|---|---|---|---|
| 51 | F | CMICU | Alveolar hemorrhage | 1-2h | Needle decompression/ 28 French Chest Tube | Left |
| 71 | M | SICU | Cardiac arrest | Not diagnosed | Fuhrman | Right |
| 81 | M | NICU | Ischemic Stroke | <1h | Fuhrman | Left |
| 83 | M | CMICU | Acute on Chronic Systolic Heart Failure | <1h | Fuhrman | Right |
| 84 | F | CMICU | Respiratory distress/hypoxia | <1h | Fuhrman | Right |
| 86 | F | SICU | Hypoxia | 10h | None | Left |

CMICU: Cardiac Medicine Intensive Care Unit; NICU: Neurology Intensive Care Unit; SICU: Surgical Intensive Care Unit

Poster 50

# Sedation Adverse Event Reporting Systems in a Non-Operating Room Setting

Christopher M Ma M.D.; James Blum M.D.

Emory University School of Medicine

**BACKGROUND**: With the growth of procedures outside the operating room (OR), the use of sedation in a non-OR environment has increased considerably. While anesthesiologists have traditionally been the physicians tasked with providing safe and effective sedation in these settings, non-anesthesiologist administration of sedation has become more prevalent.

While adverse outcomes from sedation delivery within the OR are fairly well studied, much less is understood regarding sedation protocols in nontraditional settings. With the expanding scope of procedural conscious sedation, there has not been the concomitant development of quality assurance systems to ensure the delivery of safe sedation care. We sought to develop a system to provide quality assurance for sedation cases.

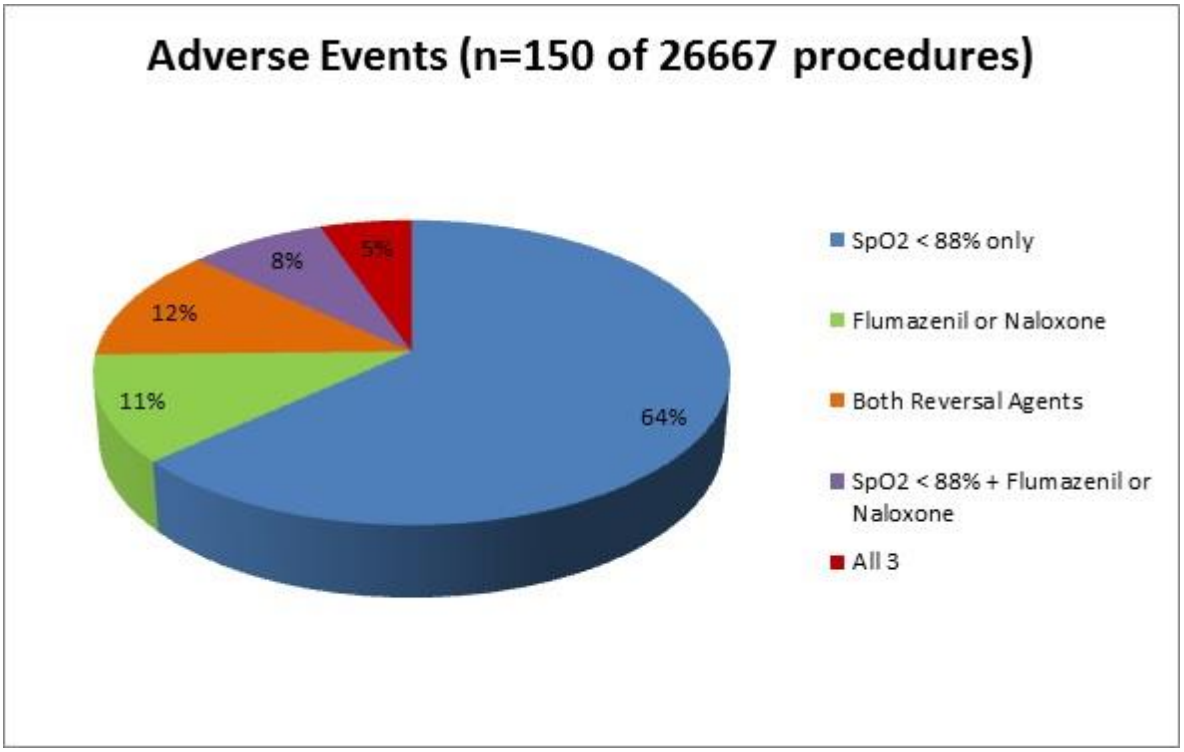
**OBJECTIVE**: This retrospective study aims to examine the utility of the electronic medical record (EMR) system in comparison to a self-reporting system in identifying the incidence of oxygen desaturation and/or use of reversal agents during non-OR procedural sedation at a university-based hospital setting.

**METHODS**: The Emory Healthcare data warehouse was used to identify all case encounters linked to the "moderate sedation" electronic order set and all case encounters linked to a CPT and or ICD-9 code for TEE, cardioversion, bronchoscopy, EGD, colonoscopy, or ERCP procedures performed by Emory Healthcare faculty from June 2013-July 2014. Demographic and clinical data were collected describing the type of procedure, department, SpO2, use of supplemental oxygen, and use of sedation reversal agents during the intra- and or post-procedural setting. The incidence of oxygen desaturation and or use of reversal agents were identified through the EMR system and compared to those identified via the current electronic incident reporting system within the same cohort.

**RESULTS**: A total of 26,667 were identified and reviewed. Of the 26,667 cases reviewed, 150 were significant for oxygen desaturation and or use of reversal agents. Of these 150 cases, 95 (63.3%) resulted in desaturation only (SpO2 < 88%), 17 (11.3%) required administration of either flumazenil or naloxone, 18 (12.0%) resulted in administration of both flumazenil and naloxone, 12 (8.0%) resulted desaturation and administration of either flumazenil or naloxone, and 8 (5.3%) of cases resulted in desaturation and administration of both flumazenil and naloxone. Overall, the incidence of events identified via the EMR was 0.56% in comparison to 0.003% from the current electronic incident reporting system.

**CONCLUSIONS**: Significantly more sedation-related adverse events were identified via the EMR system rather than the self-reporting system. Despite potential limitations, the use of an EMR based system appears to be more sensitive for adverse events compared to a self-reporting system. It is possible the EMR system may more accurately capture the incidence rate of adverse events during non-OR procedural sedation. If so, an improved adverse event monitoring system would be crucial in the

development of the quality assurance systems needed for delivering safe sedation care for a given healthcare system.



# PS01-09: PERIOPERATIVE ANESTHESIA & TECHNOLOGY, COMPUTING AND SIMULATION, EQUIPMENT MONITORING & TRAUMA

Posters: 52 - 57

**Moderator: Gyorgy Fendl, MD, PhD, FCCM**

Poster 52

# Application of Machine Learning Techniques to High-Dimensional Clinical Data to Predict Risk for Postoperative Complications

Carmen T Khorram M.D.; Azra Bihorac M.D., M.S.; Paul Thottakkara M.S.; Ashkan Ebadi Ph.D.; Tezcan Ozrazgat-Baslanti Ph.D.; Anis Davoudi Ph.D.

University of Florida

**BACKGROUND**: Approximately 51.4 million surgical procedures are performed annually in the United States, with an estimated mortality of 0.5-5%. (1) Studies suggest that this low overall mortality rate conceals the existence of a subpopulation at much greater risk of postoperative complications and death. (2) A number of risk stratification tools have been developed to help identify surgical patients with significant risk for adverse events after surgery. Many of the existing risk-assessment models are largely limited, applicable to specific surgical procedures or patient populations, and often requiring the use of specialized or costly tests. The aim of this study was to develop a widely applicable risk-assessment tool that could accurately stratify surgical patients preoperatively and offer an individualized risk assessment for postoperative complications and death in the first 30 days after surgery.

**METHODS**: This model was developed using a single-center cohort of 51,457 adult patients between 2000 and 2010 undergoing major surgery that resulted in a hospital admission of at least 24 hours. Algorithms were developed utilizing a number of preoperative clinical variables that were then modified based on probabilistic risk scores in relation to four postoperative outcomes of interest: postoperative ICU admission >48 hrs, mechanical ventilation (MV) >48 hrs, cardiovascular complications, and death within 30 days of surgical admission. A 70/30 cross validation analysis was used to assess model performance. Model accuracy was evaluated using the area under the receiver characteristic curve (AUC). Once cut-offs were established for each risk category, a relative risk assessment comparing low, medium, and high risk groups was used to demonstrate the model's discriminatory capability with regard to the postoperative outcomes of interest.

**RESULTS**: Prevalence of postoperative ICU admission >48 hrs, MV >48 hrs, cardiovascular complications, and death within 30 days of surgical admission were 32.1%,13.7%, 7.6%, and 3.5% respectively. The model demonstrated discriminatory ability with AUCs ranging between 0.77 and 0.87. Relative risks for the four postoperative outcomes ranged between 3 and 8 for medium risk patients and between 6 and 34 for high risk patients (Figure 1).

**CONCLUSIONS**: The delivery of high-quality perioperative care largely relies on accurate and individualized clinical risk prediction and effective risk management. Our model offers a reliable method for preoperative risk stratification for adult surgical patients across a wide range of surgical procedures.

Inclusion of this model in the assessment and care of surgical patients can potentially facilitate a more meaningful informed patient consent process prior to surgery, enhance goal-directed perioperative interventions, optimize resource allocation, and ultimately reduce morbidity, mortality, and hospital length of stay.(3-5)

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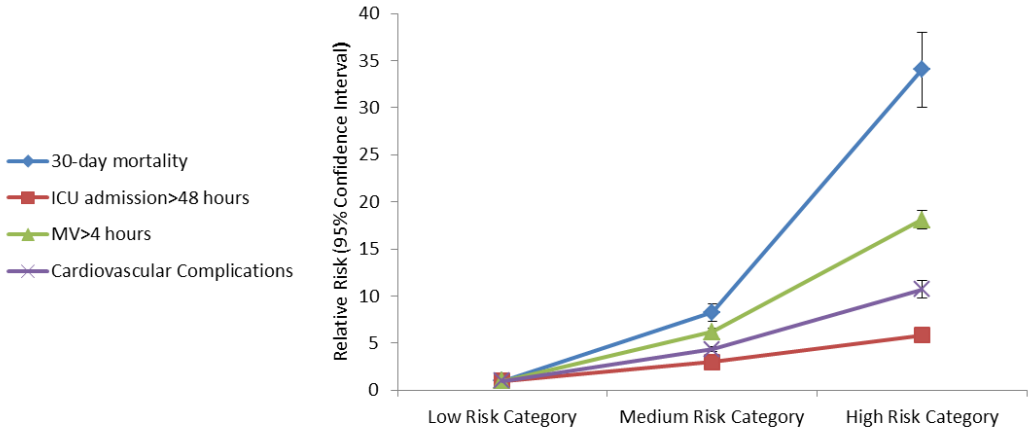


| N (%) of cohort within each category<br>Absolute Risk | - | - | - |
|---|---|---|---|
| | 40385 (78.48) | 9491 (18.44) | 1581 (3.07) |
| 30-day mortality | 1.04 | 8.54 | 35.23 |
| | 31166 (60.57) | 8756 (17.02) | 11535 (22.42) |
| ICU admission>48 hours | 13.23 | 39.56 | 77.2 |
| | 36901 (71.71) | 9232 (17.94) | 5324 (10.35) |
| MV>4 hours | 3.69 | 22.84 | 66.85 |
| | 36173 (70.3) | 13762 (26.74) | 1522 (2.96) |
| Cardiovascular Complications | 3.48 | 15.19 | 37.32 |

**Figure 1.**
Relative risks of PC for medium and high risk categories with respect to low risk group.

Poster 53

# Hyperleukocytosis Causes Falsely Elevated Point-of-Care Hemoglobin & Hematocrit Measurements

Julia R Menshenina M.D.; Julia Sobol M.D.

New York Presbyterian Hospital, Columbia University Medical Center

**Introduction**: In major operative procedures that cause significant fluid shifts, blood loss, and electrolyte disturbances, rapid point-of-care (POC) blood analysis is used to direct time-sensitive management decisions. Thus, it is important to understand the limitations of POC testing and recognize situations in which POC tests may not be accurate. We describe a case of falsely elevated hemoglobin (Hb) and hematocrit (Hct) measurements on the epoc® blood analysis system in a patient with hyperleukocytosis.

**Case Report**: A 55-year-old man with human immunodeficiency virus (HIV) well controlled on antiretroviral therapy, chronic myelogenous leukemia, Clostridium difficile colitis, and leukocytosis due to sepsis and/or blast crisis, underwent emergent exploratory laparotomy out of concern for toxic megacolon or bowel ischemia. His morning laboratory values showed white blood cell count (WBC) 275x10^9/L, Hb 8.1 g/dL, and Hct 23.3%. We were considering administering blood products during surgery to correct his anemia, but the first intraoperative epoc® Hb and Hct measurements were 13.1g/dL and 38.0%. Noting this disparity, we drew simultaneous blood samples that showed Hb and Hct of 11.7g/dL and 34.0% on the epoc® versus 6.1 g/dL and 17.7% in the central laboratory. Similar discrepancies were observed after the patient arrived in the intensive care unit and his blood was analyzed using a different epoc® machine.

**Conclusion**: The epoc® uses conductivity to measure Hct then calculates Hb from Hct. Normally, erythrocytes are the major nonconducting particles in blood, but leukocytes, proteins, and lipids can interfere. According to a 2012 epoc® technical bulletin, WBC elevation to 100x109/L increases Hct measurements by 2%; protein change of 1g/dL changes Hct by 1%; and, lipid change of 600 mg/dL changes Hct by 0.4%. However, in this patient with hyperleukocytosis to 275x10^9/L, the epoc® Hct was increased by 63-92%. The hospital laboratory uses a centrifugal method to measure Hct and a photometric method to measure Hb, so they are not affected by leukocytosis. Severe hyperleukocytosis can cause significant false elevations in Hct measurements on the epoc® blood analysis system, and this could have a profound effect on patient management.

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Poster 54

# Developing a Simulation Based Curriculum for Anesthesiology Critical Care Medicine Fellows

Jennifer M Elia M.D.; Arna Banerjee M.D., FCCM

Vanderbilt University Medical Center

**Introduction**: Anesthesiology training programs have implemented high-fidelity simulation as a means to educate residents and two specialty boards now include simulation as part of their primary certification. Its utility has been demonstrated in education particularly as related to crisis resource management and teamwork. Expectations continue to rise for residency and fellowship programs to provide integrated simulation training but currently there are no guidelines for developing effective simulation based curriculums. To help establish a formal simulation curriculum, we surveyed current Critical Care Anesthesiologists from our program who received regular simulation training in their fellowship.

**Methods**: A 14-question survey was developed to assess the utility of the current simulation curriculum and sent via email to past fellows of the _____ Anesthesia Critical Care Fellowship from 2008-2015 (n=37). We asked participants to rate the utility of the current simulation curriculum as related to both their fellowship training and their current practice.

**Results**: Nineteen of 37 prior fellows completed the survey. Fifteen of these (78.9%) currently work in an academic setting, and the percent effort dedicated to critical care practice varied from 0-80% (median 20-40%). Fifteen responders (78.9%) stated that simulation was a valuable component of their fellowship training and 14 (73.7%) stated that simulation should be required in Critical Care fellowship training. The topics they found most useful to both their fellowship training and current practice included anaphylaxis, leadership and communication in code situations, acute liver failure, and local anesthetic systemic toxicity.

**Conclusion**: Our results suggest that most recent graduates from a Critical Care Anesthesiology Fellowship find simulation training useful for both educational and practical purposes. Participants found a variety of scenarios in our curriculum helpful, and we feel that this needs assessment can be used to develop a robust simulation curriculum in Anesthesiology Critical Care.

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Poster 55

# Designing a Novel Manual Communication System for Mechanically Ventilated ICU Patients

Miriam A. Madsen M.Eng., M.D.[1]; Leigh R. Hochberg M.D., Ph.D.[2, 3, 4]; Stephen O. Heard M.D.[1]; J. Matthias Walz M.D.[1]

University of Massachusetts Medical School[1]; Brown University[2]; Massachusetts General Hospital[3]; Providence VAMC[4]

**Introduction**: Current research shows that the existing methods for mechanically ventilated (MV) ICU patients to communicate are insufficient. While a number of basic communication methods are often tried with these patients (such as writing on whiteboards/clipboards, use of letter boards, and mouthing words), patients and caregivers consistently report dissatisfaction with available methods and limited success in their use. [1] Furthermore, patients consider the lack of successful communication strategies to be extremely stressful. [2] The ICU setting is more complicated for assistive communication technology use than other settings due to patient population heterogeneity; variation in individuals' physical/cognitive capabilities over time; robustness and hygiene concerns for communication tools; and a lack of available training time prior to patients' need for communication assistance.

**Methods**: We are developing a communication system that is easily accessible by MV patients who lack sufficient dexterity to write clearly due to complications of critical illness. Using this novel system, a patient will manually operate a hand-held component that communicates in real time with a tablet computer, producing audiovisual content specific to ICU patient needs. Three sets of system requirements have guided the design of this technology: features required by the ICU setting, by the patient, and by the nurses/care team. Features required by the ICU setting include the presence of ICU-specific topics and cost-effective design that is appropriately hygenic. The patient-related system requirements involve a short learning curve; hardware and software that is adaptable to individual patients; and inclusion of non-medical topics of value to patients and their families. Synthesized speech output and some form of tactile feedback are also planned for the final system version to meet patient needs. In considering the requirements of the nurses and care team, the system should be accessible despite physical restraints and should demonstrate a patient's level of responsiveness, allowing for a clearer assessment of a patient's cognitive state.

**Results**: This system has been demonstrated in its prototype form to physicians, nurses, researchers, and engineers. Based on their feedback, we have prepared more than a dozen improved versions of the device in preparation for deployment with MV ICU patients. Figure 1 shows the design of the communication device in its current version. The system will undergo proof-of-concept testing in a pilot trial in MV patients.

**Conclusions**: Existing communication methods for MV ICU patients do not meet the emotional and logistical needs of these patients. We are designing and testing a new communication system with the

goal of allowing MV ICU patients to communicate despite a variety of physical impairments.

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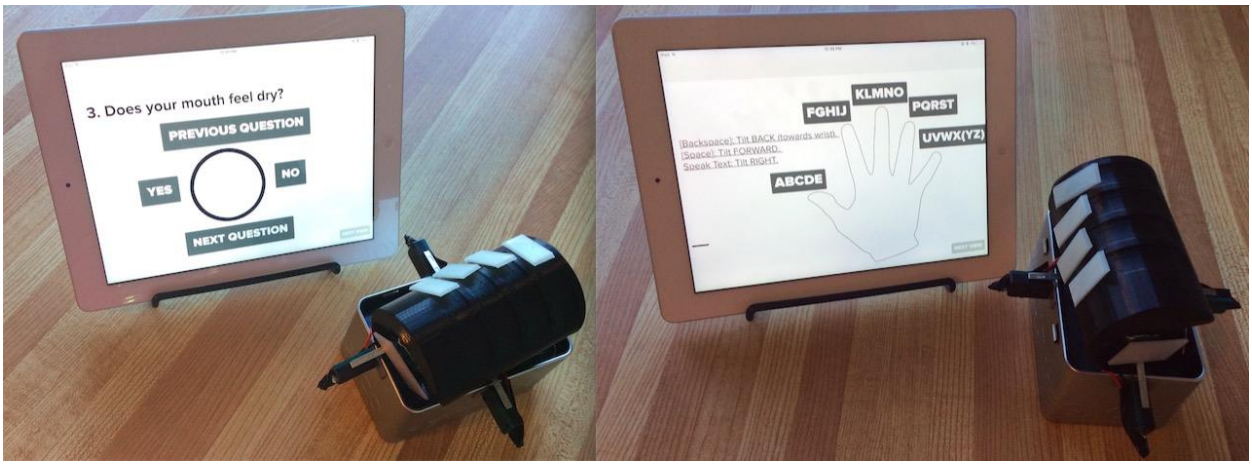

Poster 56

# Acute Right Heart Failure Caused by Systemic Air Embolism in Penetrating Chest Trauma

Julin F. Tang M.D., M.S.; Philip Kurien M.D.; Stefan Simon M.D.; Catherine Juillard M.D.; Arthur Hill M.D.

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**Introduction:** Systemic air embolism from penetrating chest trauma has been well reported. The acute right ventricular failure due to the air embolism from chest trauma is rare and can be fetal. We report a case of acute right heart failure during the surgical repairs of the left lung and the left ventricular laceration in a patient with chest penetrating trauma. The intraoperative findings of right ventricular dilatation and decreased systolic function were visualized by the surgeon and confirmed with the transesophageal echocardiography (TEE). This case is a rare intraoperative TEE finding of systemic air embolism due to penetrating chest trauma.

**Case Presentation:** A 21-year-old otherwise healthy female who was stabbed to the left chest presented to the emergency room with left pneumohemothorax. Patient was transferred to the operating room after left side chest tube placement and fluid resuscitation. The induction and intubation were uneventful and positive pressure mechanical ventilation was initiated. Exploratory laparotomy was done initially with the findings of hemoperitonem, left lobe liver laceration, left diaphragm laceration and pericardial injury. A median sternotomy was performed to evaluate the cardiac injury. A partial thickness left ventricle laceration was repaired with a ligation of obtuse marginal vein. Exploration of the left thorax was also noted to have a small left lower lobe laceration. However, surgeon suddenly noted the heart turning boggy and purple. Patient began to have profound hypotension and cardiogenic shock. Cardiac massage was performed and intra-cardiac 200 mcg of epinephrine was given. TEE also showed right ventricular dilatation and reduced systolic function consistent with acute right heart failure. There were no regional wall motion abnormalities of the left ventricle. The patient was resuscitated and supported with dobutamine and flolan. She was transferred to ICU for further care. The transthoracic echocardiography examination showed similar mild-to-moderate reduced right ventricular systolic function. The final reading of the intraoperative TEE was noted to have air emboli in the left side of heart.

**Discussion:** This case is a perfect example of systemic air emboli flowing into the right coronary artery and causing an acute right heart failure. Complication of coronary arterial air embolism has been well described during cardiac catheterization procedure with an incidence of 0.3 to 1%. Systemic air embolism from blunt or penetrating chest trauma is rare but exist. Most of the reported cases have been either fatal or with residual cerebral and cardiovascular complications. The air emboli were thought to come from the bronchial pulmonary vein fistula created by the trauma. This case report attempts to demonstrate the use of TEE as a valuable adjunct to conventional monitors during trauma resuscitation.

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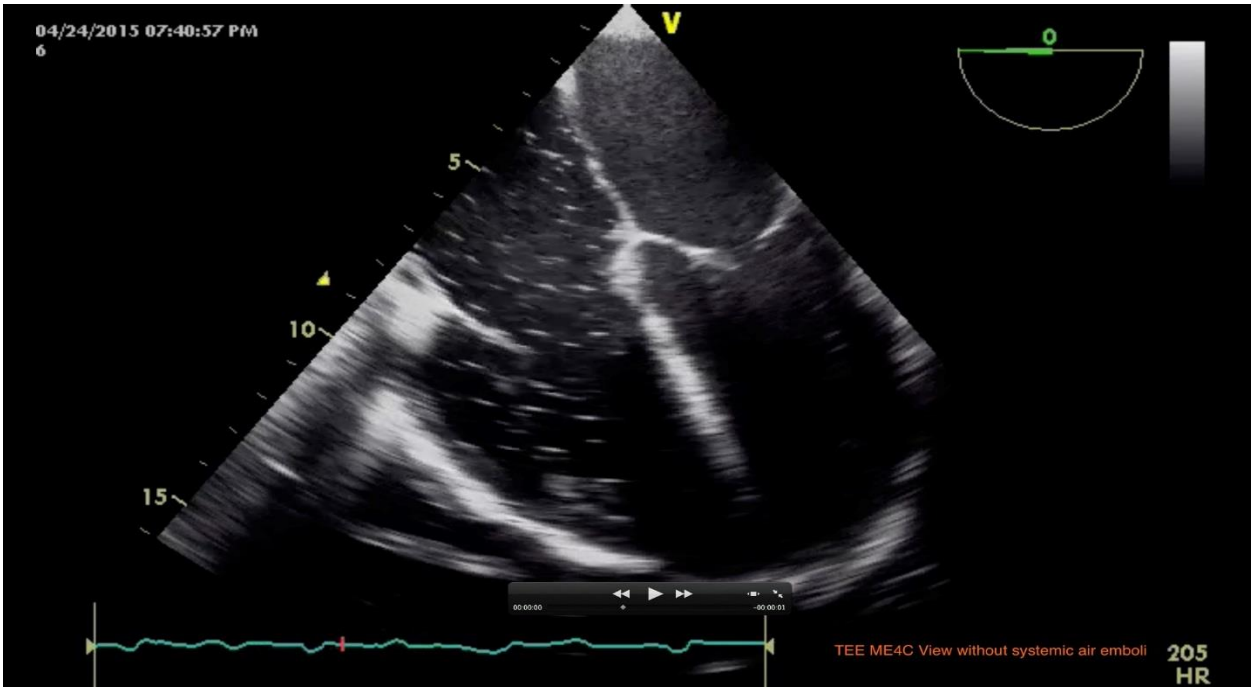


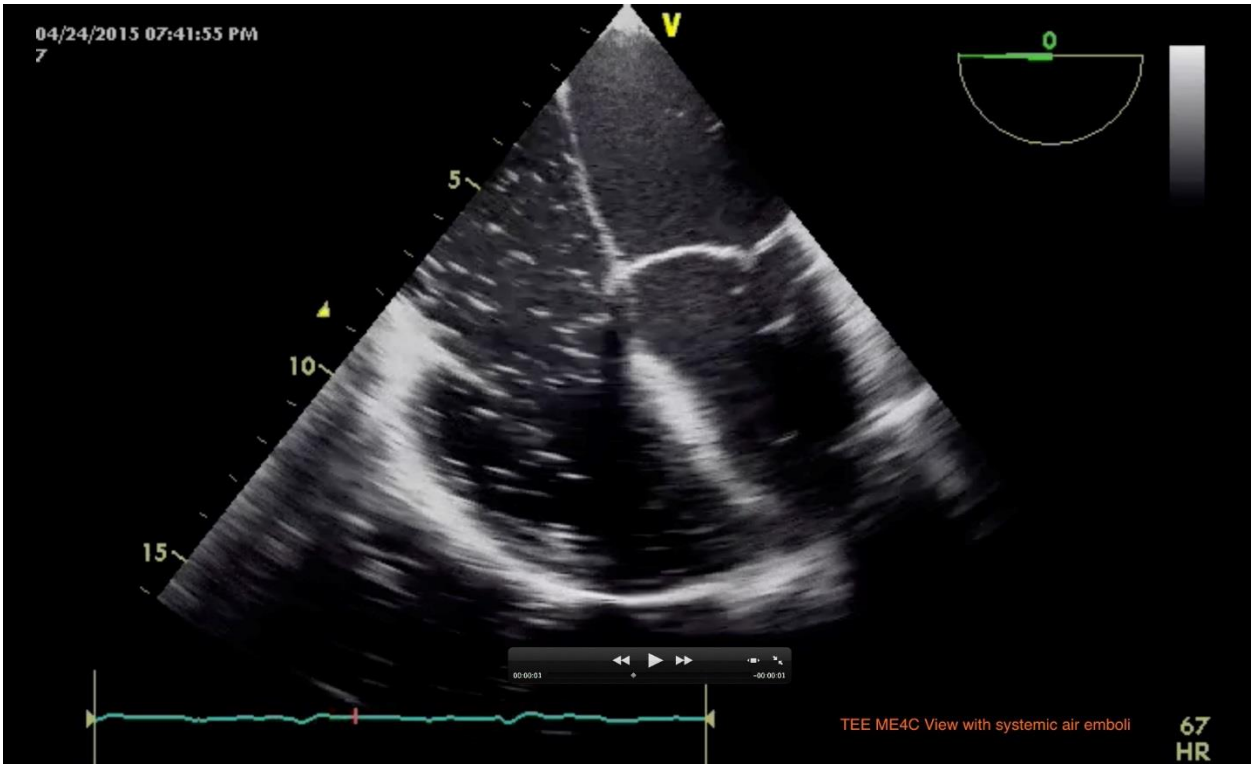

Poster 57

# Unilateral Diaphragmatic Paralysis Following Trauma Causing Respiratory Failure

Riaz Mohammed Karukappadath M.B.B.S.; Lori Circeo M.D.

Baystate Medical Center, Springfield, Massachusetts

Unilateral diaphragmatic paralysis following trauma is rare. It usually does not cause any respiratory distress or causes minimal respiratory distress without any need for additional respiratory support. When the diaphragmatic paralysis is accompanied by other factors which compromise respiratory function, it can lead to respiratory failure. We present this case, of a young male with no history of any lung disease, who had a traumatic unilateral cervical cord contusion, with unilateral hand weakness who required mechanical ventilation for respiratory failure. He was found to have persistent atelectasis of the right lower lobe of the lungs each time he was weaned from mechanical ventilation, which was later diagnosed as right diaphragmatic weakness by fluoroscopy. His hospital course was complicated by hospital acquired pneumonia, mechanical ventilatory support and multiple bronchoscopies for establishing a diagnosis. This case highlights the importance of maintaining a high index of suspicion in patients with unilateral cervical cord trauma and upper limb weakness for diaphragmatic dysfunction.

# SOCCA Presentations Table of Contents

# Speaker Presentations

**Anesthesia Quality Institute and ICU Metric**
Avery Tung, MD, FCCM

*N.B. To facilitate looking up the relevant references, this document is footnoted using Pubmed IDs. When a >6 digit number appears in parentheses, clicking on it or typing that number into the Pubmed search engine will bring up the relevant reference.*

**1a. Introduction: the AQI**

A critical challenge in Anesthesia quality is the need to obtain descriptive and benchmark information on adverse events related to anesthesia care. Because such events are rare, and occur against a background of different hospitals, surgeons, and patients, however, comparing events and outcomes from individual hospitals or groups is difficult. Established in 2008, the Anesthesia Quality Institute (AQI) is an American Society of Anesthesiologists effort to generate a national database (NACOR, or National Anesthesia Clinical Outcomes Registry) sufficiently large to allow direct risk adjusted comparisons for anesthesia cases, outcomes, and adverse events.

Despite extremely rapid growth, the AQI has had some difficulty fulfilling its promise. Challenges in integrating paper and electronic data, defining risk factors (such as hypotension) and outcomes (prolonged emergence), wrestling with incomplete data sets, and overcoming challenges in data collection have all limited the utility of the millions of cases in the registry. Unlike established national databases like that maintained by the Society of Thoracic Surgeons (STS) (26686440), NACOR must include operations as diverse as cataracts and heart transplants, and the full range of anesthesia types. Although publications have emerged from the NACOR database (25390278 and 26947712), they have mostly been descriptive as data inconsistencies have limited more rigorous analysis.

**1b. The AQI and Critical Care**

The above challenges in creating a useful database of cases, outcomes and events have also limited AQI attempts to create an ICU database. The wide diversity in Anesthesia-operated ICUs, variable case populations and surgical procedures, and range of local practices have made extracting meaningful ICU data difficult, and when coupled with challenges in information transfer, have prevented efforts to generate an ICU specific database using NACOR.

The AQI has recently undergone a revamping, with efforts to standardize data and outcome definitions. Although defined primarily in relationship to a surgical procedure, several AQI-defined outcomes have some relevance to Critical Care. Among these are postoperative pulmonary edema, stroke, acute kidney injury, respiratory failure/reintubation, iatrogenic pneumothorax, line-associated infection, and adverse drug reaction (https://www.aqihq.org/qualitymeasurementtools.aspx). Unfortunately, these outcomes may not be as relevant to improving ICU quality.

**1c. Quality metrics in the ICU**

What elements do constitute quality ICU care? How would such care be measured? The answer(s) to this question are as varied as the types of patients cared for by Anesthesia-run ICUs. Should an ICU have carts dedicated to central line insertion? A sedation or weaning protocol? DVT prophylaxis rates > 95%. A mortality rate 15% for patients with ARDS?

# Speaker Presentations

**The Anesthesia Quality Institute and ICU Metrics**
Avery Tung, MD, FCCM

This talk will discuss challenges in creating, measuring, and benchmarking quality metrics in the ICU, review the literature supporting and describe the new CMS-approved SEP-1 metric

(http://www.jointcommission.org/specifications_manual_for_national_hospital_inpatient_quality_measures.aspx), which will likely be shared between the ER and ICU and specifies key steps in early sepsis management.

***2. What is quality, anyway?***

ICU quality might best be defined as optimal care of critically ill patients. It is thus different from ICU safety, which describes the minimization of errors and prevention of adverse events. A care process can always be made incrementally safer… for example stationing a fiberoptic cart in front of every room in case emergent airway management is needed, or having an emergent tracheostomy kit at the bedside for every ICU tube exchange. But such approaches may not improve ICU quality, which involves the optimization of care along more than just the "prevent errors" axis. Axes for quality may also include elements such as efficiency, cost, and/or patient satisfaction which do not

**3. Structure, Process and Outcome…in the ICU**

In 1988 Donabedian first suggested a taxonomy of quality medical care (3045356) that categorized quality efforts as either structural (relating to the environment of care), process (relating to the delivery of care), or outcome (relating to the result of care). In his article, Donabedian presaged many of today's quality challenges by noting that limitations in medical knowledge and inconsistencies in cause-effect relationships prevented any single quality category from being superior or more relevant than any other.

Donabedian's observations accurately describe many elements of ICU quality today. Structural aspects of acute care such as rapid response teams (26850331), isolation of patients with MRSA (18334690), and 24-7 night call (22612639) may not consistently lead to improvements in ICU outcomes, and although the use of central line "carts" to systematically organize supplies was an important element to reducing CLABSI rates in the Keystone project (17192537), equally low rates have been achieved by organizations without the use of such a cart.

Process measures have likewise had mixed effects on the quality of ICU care. A surprising lesson of the recently concluded national Surgical Care Improvement Project is that process measure adherence often may not improve associated outcomes. SCIP measures with ICU involvement such as VTE prophylaxis (24100354), tight glucose control in cardiac surgery patients (24418668 although the tide may be turning…see also 26079777), and early urinary catheter removal (largely bypassed…see 23070409) are all examples of strategies with supportive evidence and common sense, but mixed effect on outcomes.

Although surprising, the failure of widespread dissemination of specific structural or process measures to improve outcomes in all ICUs is plausible. Because local practices, procedures, environments (and patients) may all be different, strategies to extract the best outcomes for those patients might reasonably vary. But as Donabedian noted, a multitude of factors may affect outcomes…and comparing

**The Anesthesia Quality Institute and ICU Metrics**
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outcomes as a strategy to identify best practices introduces its own challenges. Definition and capture (of outcomes), and the need to risk adjust for differences in patient populations are both nearly insurmountable roadblocks to believable, reproducible outcome comparison.

The AQI is currently soliciting feedback for an outcomes "definition" list that addresses the former issue. A quick look demonstrates the difficulty of unambiguously defining outcomes for purposes of quality reporting. Respiratory arrest is defined as the cessation of spontaneous breathing for longer than 60 seconds, organ failure is "altered function of one or more vital body system organs such that homeostasis cannot be maintained without intervention", and coagulopathy is "the impairment, inability, or incapacity of the blood to form clots associated with clinical bleeding"

It is easy to quibble about these definitions. But they matter with respect to risk adjustment, without which incidence data are considerably less useful. Experience with preoperative antibiotics suggests, for example, that treated as a continuous variable, a relationship between time before surgery and infection may exist (23552769), but that adherence to the SCIP INF-1 60 minute metric has little effect (18471703). And, dichotomizing outcomes based on non-evidence based thresholds (why cessation for >60 seconds and not 75?) may predispose to gaming by offering a target for exemption. Variability in reporting STS database elements such as urgent or emergent status (20546798) suggest that data elements relevant to risk adjustment may be vulnerable in this regard.

***4. Is there any hope?***
That comparative data on structure, process, or outcome performance may not be readily usable clearly does not mean that quality improvement is not possible. Although the entire CLABSI reduction bundle proposed in the Keystone project has not been implemented everywhere, recognition that substantially lower CLABSI rates are possible has led to widespread decreases…and accepted CLABSI rates more than 5fold lower (http://www.cdc.gov/mmwr/pdf/wk/mm60e0301.pdf). The promotion of internal quality improvement projects as publishable reports (http://www.jgme.org/doi/pdf/10.4300/JGME-D-1600086.1) may easily lead to dramatic changes in practice as quality-minded physicians read about other efforts and choose (or not) to trial them locally. Obliteration of the benefit derived from daily sedative interruption (from 10816184 to 23180503 in 11 years) suggests that "baseline" clinical practice (in this case the use of deep sedation in ICU patients) may evolve rapidly with very little explicit evidence.

***5. The new SEP-1 measure: Process measures arrive in the ICU!***
Prior to the introduction of SCIP in 2006, CMS did have a suite of process measures for the ICU ready for deployment (http://www.jointcommission.org/national_hospital_quality_measures_-_icu/). Among these were 4 measures now considered commonplace in the ICU (Positioning for VAP, Ulcer & DVT prophylaxis, and CLABSI rate), and two that would be tracked for their future utility (risk adjusted LOS and hospital mortality). However, these measures were never implemented due to the rollout of the SCIP program instead, which included some elements (DVT) of the ICU bundle.

# Speaker Presentations

**The Anesthesia Quality Institute and ICU Metrics**

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The SEP-1 measure, live since October 2015, incorporates a bundle of therapies targeted at early sepsis treatment (http://www.jointcommission.org/specifications_manual_for_national_hospital_inpatient_quality_measures.aspx). Among the elements in this "all or none" bundle for patients presenting with a diagnosis of sepsis or septic shock (standard SIRS criteria) are a 3 hour benchmark (lactate level, blood cultures, broad spectrum antibiotics, and 30 cc/kg crystalloid bolus) and 6 hour benchmark (repeat lactate if original >2, vasopressor if hypotension persists, and an assessment of volume status/tissue perfusion if hypotension persists.

The history of SEP-1 is worthy of review as it illustrates the difficulty of creating a quality measure for the ICU. Initially proposed in 2007 by the authors of the 2001 Goal directed hemodynamic management paper (11794169), the measure included central line insertion and SvO2 measurement and was approved by NQF in 2012. Strong protest by the American College of Emergency Physicians regarding the difficulty of identifying "time zero" and the utility of central venous monitoring, however, forced an ad-hoc review in 2014 by the NQF Patient Safety committee (25 members, no anesthesiologists, one CRNA). Informed by results from the PROCESS (24635773) and ARISE (25272316) trials, and after ferocious commentary from supporters and foes of central line insertion, the committee elected to rescind the requirement for central line insertion and SvO2 measurement. In its place is a choice of focused exam (vital signs, heart/lungs, capillary refill/peripheral pulse evaluation) or two indicators of perfusion (CVP, $CVO_2$, bedside ultrasound, passive leg raise).

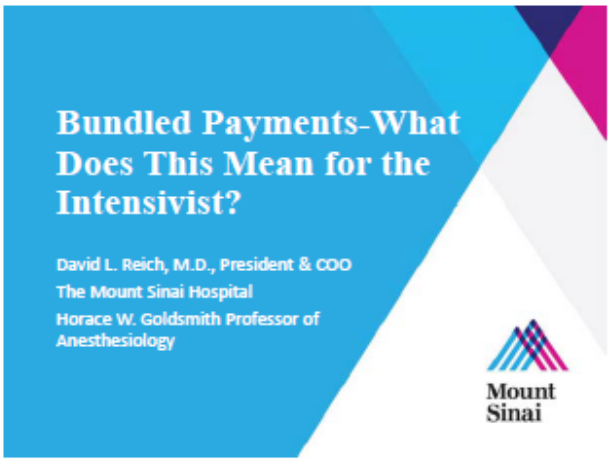
The discussion about whether unbundling the original EGDT intervention constitutes evidence-based therapy, or the balance between risk and harm with central line insertion is fascinating to read….but sheds light onto the challenge in generating and using quality metrics for ICU patients. And reversion to process measures suggests an inability to risk adjust effectively across ICUs. But since subtle, relevant elements of an ICU environment are difficult to ascertain, the best hope for replicating successful treatment pathways in other environments seems still to be process measure. Time will tell if SEP-1 is able to consistently improve sepsis-related outcomes.

**6. Summary**

Although AQI does not currently have quality metrics devoted to ICU care, the current project to standardize definitions and outcomes will incorporate outcomes relevant to the ICU. Perhaps a greater challenge to ICU quality is identifying what and how to improve. Whether due to inherent complexity or variability in environments and patients, interventions or approaches that generate reproducible benefits across all ICUs are rare. Nevertheless, improvement in meaningful ICU outcomes such as central line infections or even ARDS (18263687) has occurred. The new SEP-1 measure, nearly 10 years in the making, introduces CMS-sponsored, ICU-targeted process measures into the intensive care environment for the first time. Controversy over elements of SEP-1 illuminates the difficulty in generating ICU metrics, and widely applying care metrics to diverse environments.

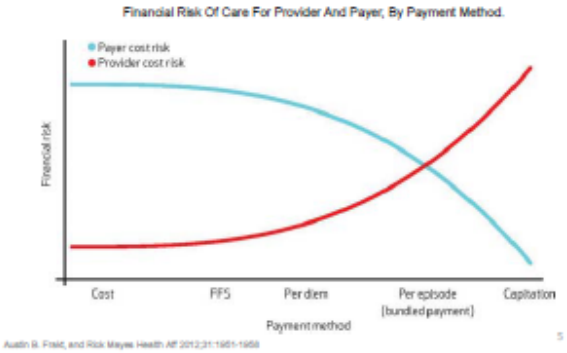
# Speaker Presentations

Bundled Payments – What Does This Mean for the Intensivist?
David L. Reich, MD

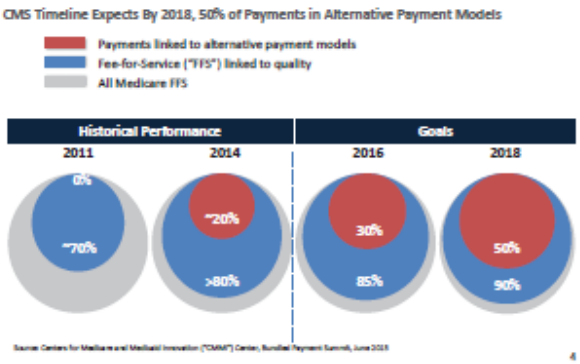



Disclosures: None

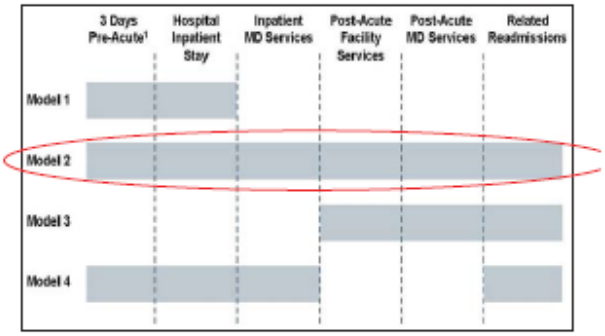
Financial risk is shifting from payors to providers




A National Transition to Value-Based Reimbursement




Bundled Payment for Care Improvement (BPCI)



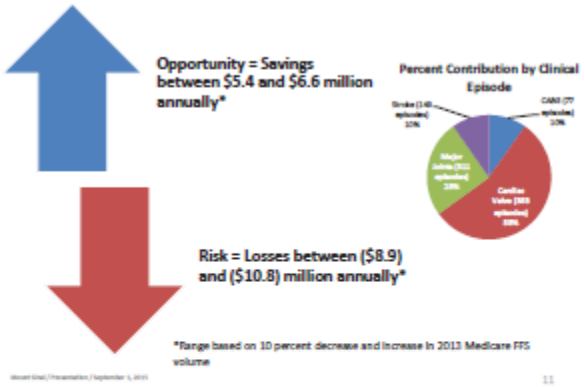

BPCI Enrolled Clinical Conditions at MSHS

| CMS Initiative | Active Sites | Go-Live Date |
|---|---|---|
| Joints- Bundles | • MSH<br>• MSQ<br>• MSR<br>• MSSL | 4/1/2015 |
| CABG- Bundles | • MSH<br>• MSSL | 4/1/2015 |
| Valve- Bundles | • MSH | 4/1/2015 |
| Stroke- Bundles | • MSH<br>• MSQ | 10/1/2015 |

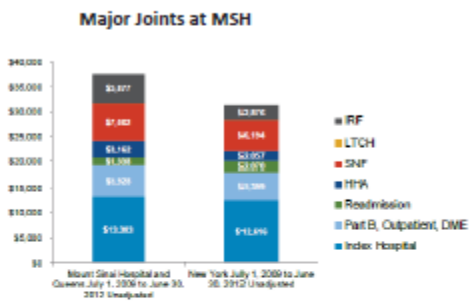
# Speaker Presentations

**Bundled Payments – What Does This Mean for the Intensivist?**
David L. Reich, MD

### Financial Stake at MSH: Opportunity and Risk




### Average 90-Day Episode Cost by Service Type

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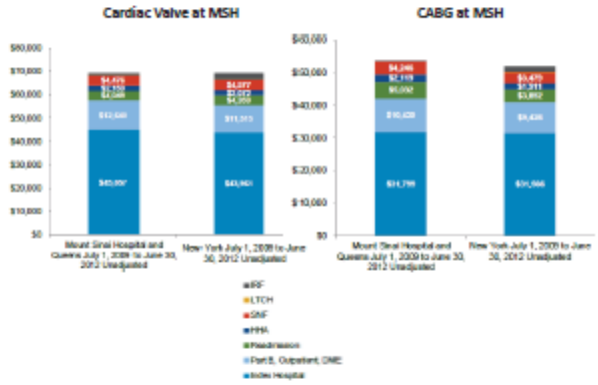



### Key Priorities for Financial Success

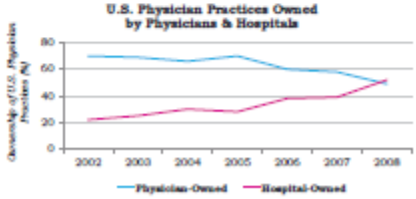
- Standardizing care
- Reducing post-acute costs
- Preventing readmissions

### What is the future of Bundled Payment?

- Current state
  - Reimbursement rates from government and private payors are falling
  - Stiff competition among health systems
  - Increasing demand for transparency on price and outcomes
  - Rise of consumerism in health care
- Future state
  - Health care sector is moving toward more value-based contracts
  - Bundled payment is becoming mandatory
- Opportunity
  - Success is determined by offering the highest value in the marketplace

### What Health Reform Means for Physicians…

- Shift from Private to Group Practices
  - More than half of practicing physicians are employed by groups
  - U.S. hospitals have experienced a 75% increase in physician employment since 2000

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# Speaker Presentations

**Bundled Payments – What Does This Mean for the Intensivist?**
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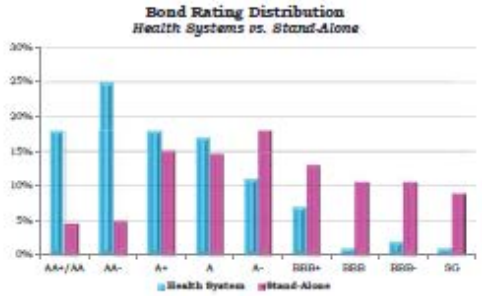
## Health Systems vs. Stand-Alone AMC

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## A Competitive Health Care Market


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## Why Value?


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## Value-Based Purchasing

| Policy | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|
| Hospital Inpatient Quality Reporting Program | -2.0% | -2.0% | -2.0% | -2.0% | -1.0% | -1.0% | -1.0% |
| Meaningful Use + Incentive Payments - | .5% | 1.7% | 1.7% | 1.3% | 1.4% -1.0% | -2.0% | -3.0% |
| Hospital Acquired Conditions (Current) | -.02% | -.02% | -.02% | -.02% | -.02% | -.02% | -.02% |
| Hospital Acquired Readmissions (ACA) | | | | | -1.0% | -1.0% | -1.0% |
| Readmissions | | | -1.0% | -2.0% | -3.0% | -3.0% | -3.0% |
| Hospital Value-Based + Purchasing - | | | 1.0% -1.0% | 1.25% -1.25% | 1.5% -1.5% | 1.75% -1.75% | 2.0% -2.0% |

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## Guiding our Priorities

- Baseline performance
- Penalty avoidance
- P4P opportunity
- Potential for impact on market share
- Reputation and ranking risk/opportunity
- Regulatory risk
- Institute of Medicine dimensions of quality
  - Outlines six aims for health care improvement
    - Safe, effective, patient-centered, timely, efficient, equitable

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## Comprehensive & Integrated Care Coordination

# Speaker Presentations

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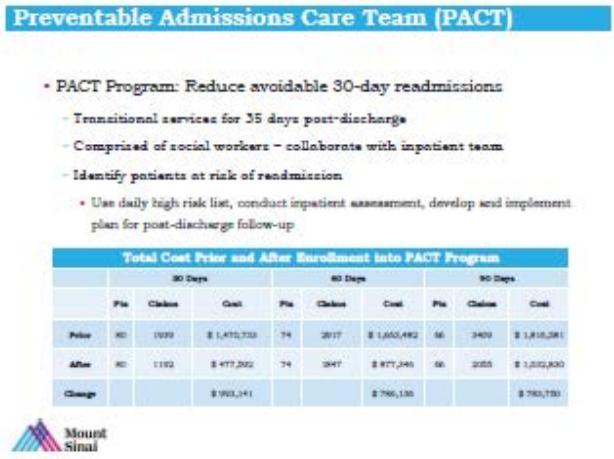


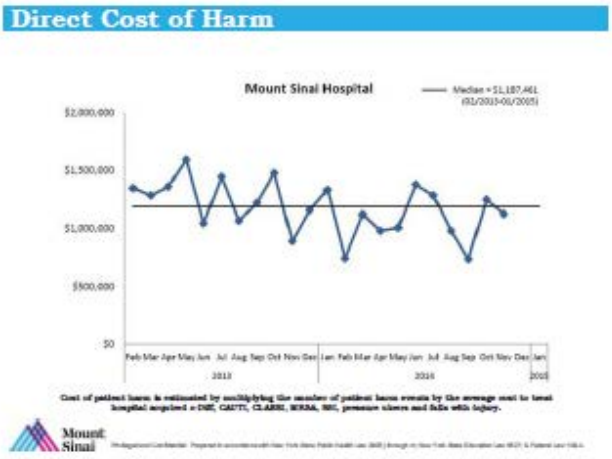


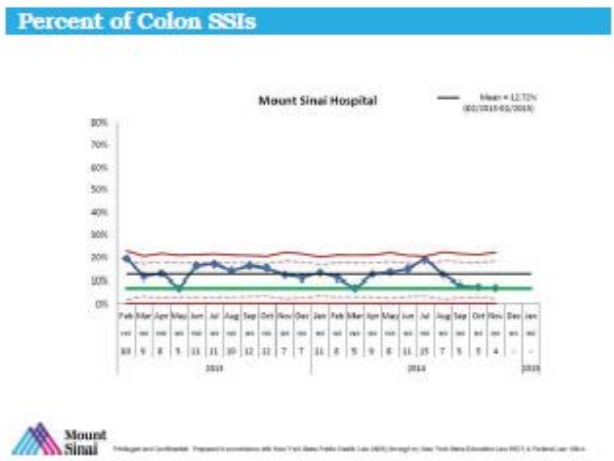


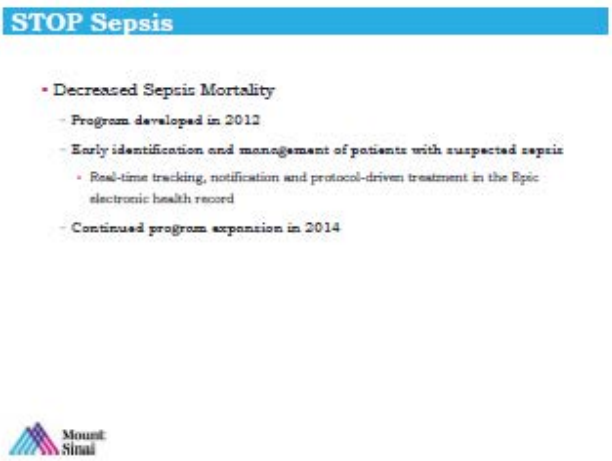



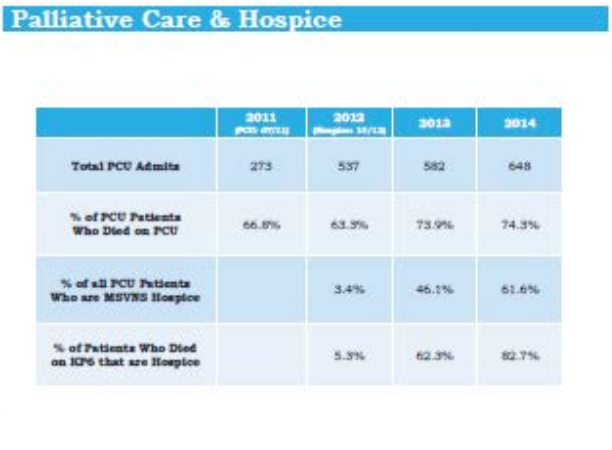


| | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|
| Total PCU Admits | 273 | 537 | 582 | 648 |
| % of PCU Patients Who Died on PCU | 66.8% | 63.3% | 73.9% | 74.3% |
| % of all PCU Patients Who are MSVNS Hospice | | 3.4% | 46.1% | 61.6% |
| % of Patients Who Died on ICP6 that are Hospice | | 5.3% | 62.3% | 82.7% |

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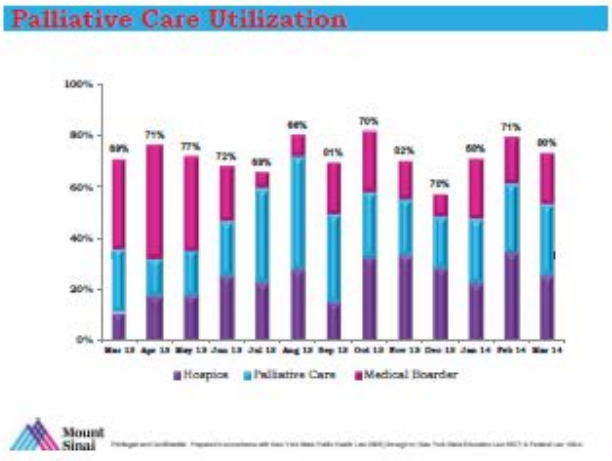


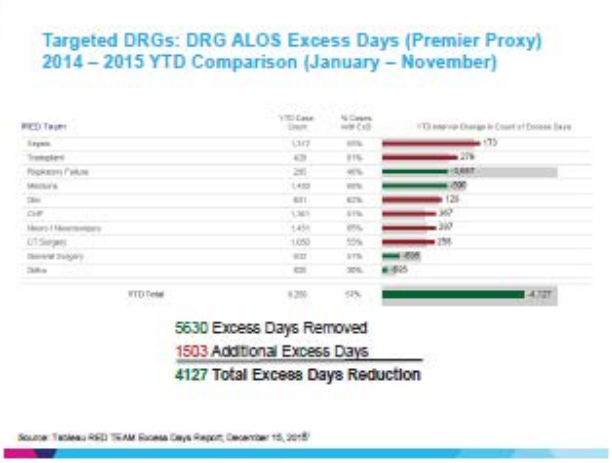


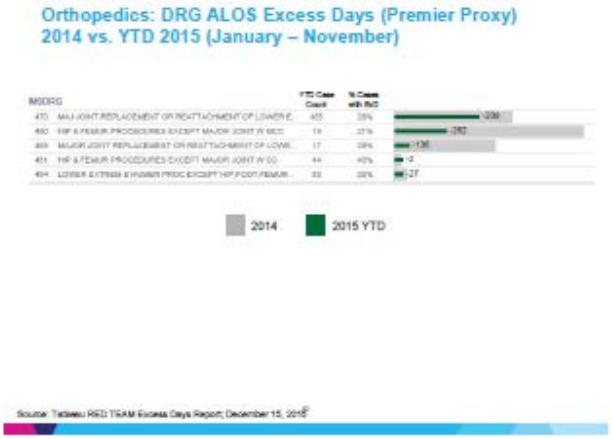


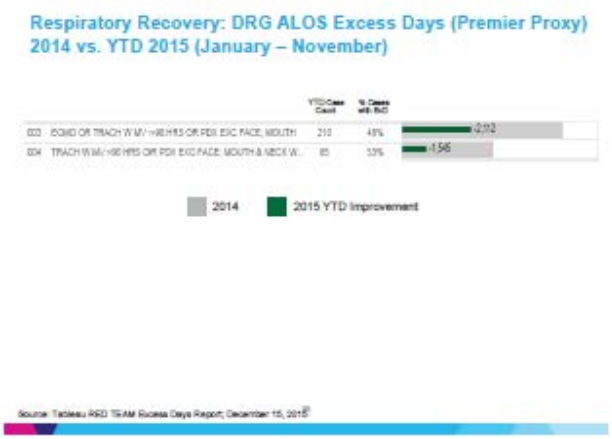


## Respiratory Recovery: Recent Progress

- Continued multi-pronged approach to long stay patients: Review by MD/RN ICU leadership, Case management and Hospital Administration
- Educated ICU staff using revised guidelines and initiated use of revised paper pathway on all units
- 12/10/15 Initial planning meeting with Medicine physician and nursing leadership to discuss roll-out of Respiratory Recovery Pathway to floors
- PT leadership examined utilization of resources and mobilization needs and current efforts for patients on pathways; findings reported to Dr. Reich and Dr. LoPachin (12/14/15)
- Continue biweekly review of the clinical status of MSH LTAC patients
- RRP Leadership met with Chaylm Aruchim leaders to facilitate early engagement of organization in appropriate patients

## Respiratory Recovery: Next Steps

- Continue analysis of pathway to identify areas of success and improvement
  - Days to Trach & PEG
  - Completion of family meetings
  - Documentation of goals of care discussions
- Work with Epic team to build Respiratory Recovery Pathway in Epic and establish reporting needs by end of 2015
- Roll out respiratory pathway to 9W in Q1 2016
- Provide feedback of clinical status and outcomes of MSH to LTAC patients to providers
- Identify new physician champion for RED committee

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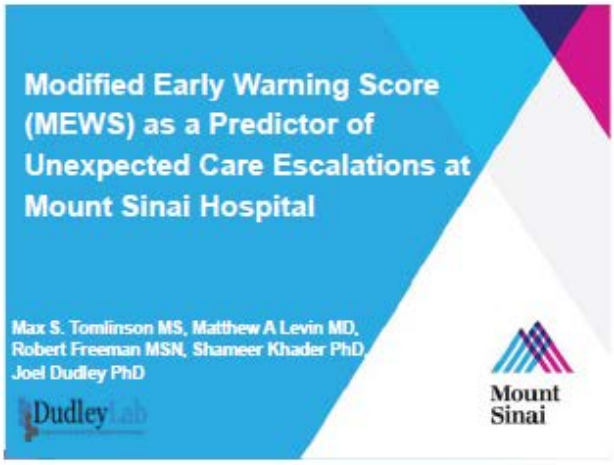
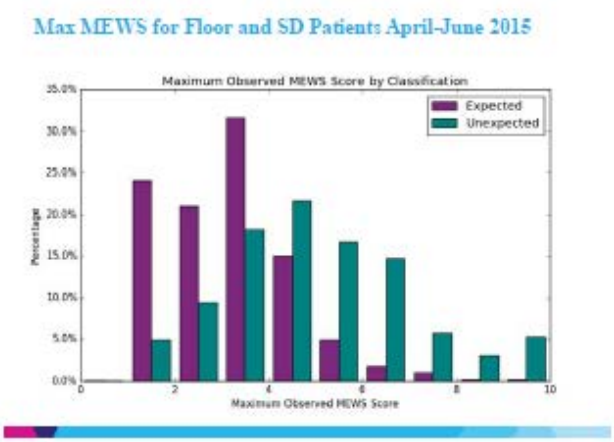
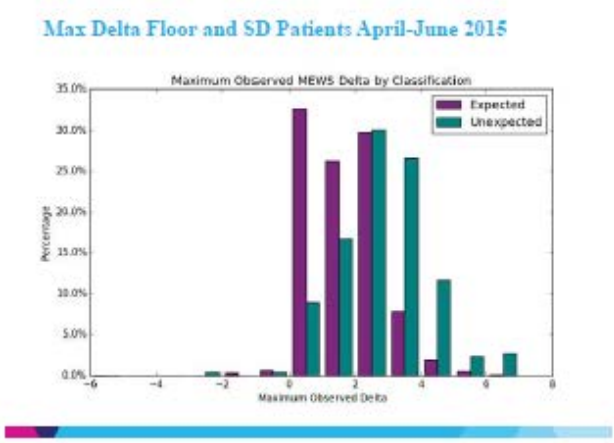
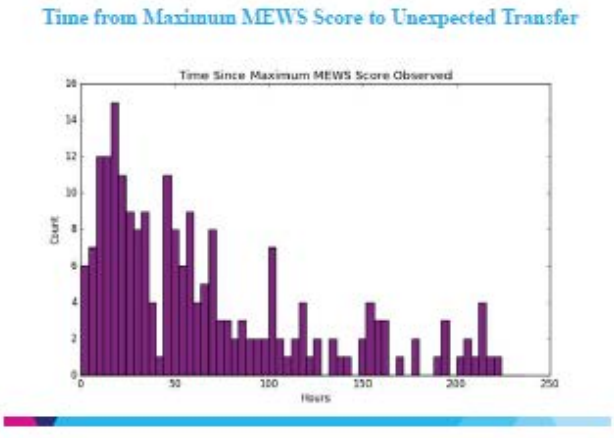


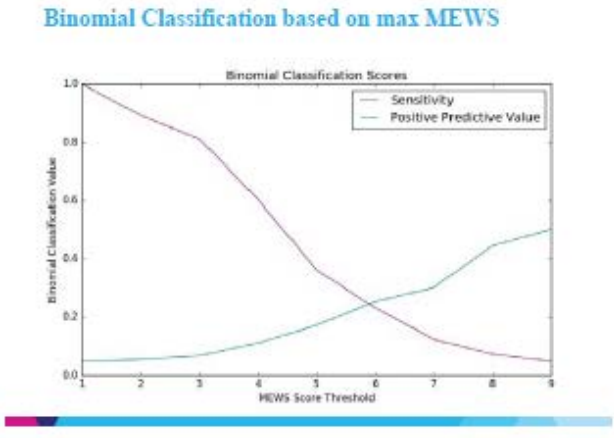






# Speaker Presentations

**Bundled Payments – What Does This Mean for the Intensivist?**
David L. Reich, MD

### Summary

- Created algorithm to accurately identify unexpected escalation of care
- MEWS performance at MSH is consistent with literature on effectiveness of MEWS scoring
- In general, previous studies have had much smaller sample size.
- We have the capability to train our model on much larger patient population

### Next Steps

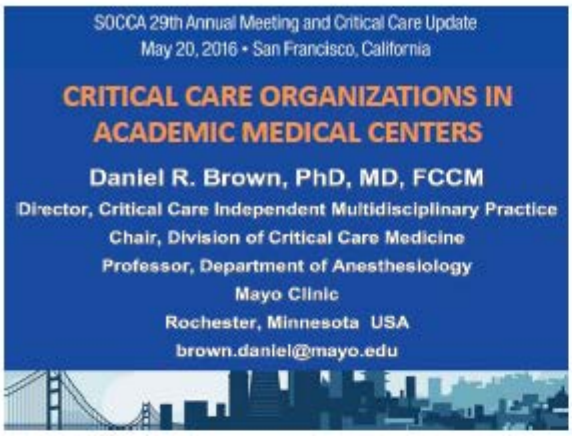
- Incorporate more raw data such as lab tests, additional vitals and meta data, such as change in heart rate over time.
- Find MEWS+ score using a ML classifier.
  - Normalized so that it can be used even if data is missing.
  - Is continuous to allow for inputs with small effects.
  - Trained on EHR data.
  - Start by trying multiple classifier methods in Scikit-Learn Python package

### Conclusions

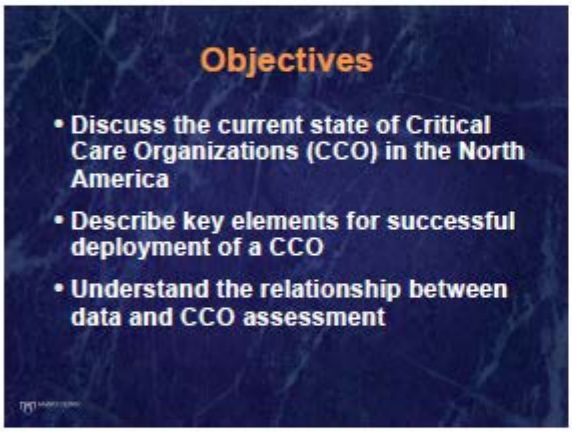
- ICU is at epicenter of health care cost spending for inpatient care of complex patients
- Win at the bundles
  - Control laboratory, imaging, consultation, and pharmacy costs
  - Positively affect outcomes
  - PI projects focused on negative outcomes of clinical and financial concern
    - Respiratory Failure
    - Avoidable Harm
    - Rapid response teams

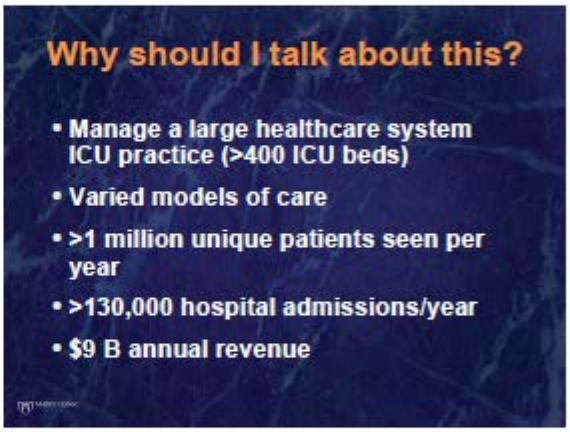
# Speaker Presentations

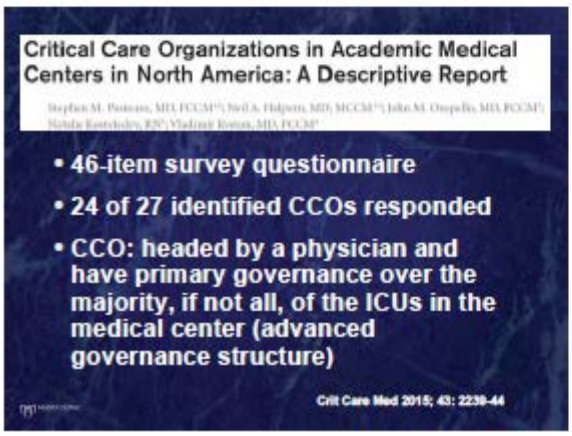
**Critical Care Organizations in Academic Medical Centers**
Daniel R. Brown, MD, PhD, FCCM

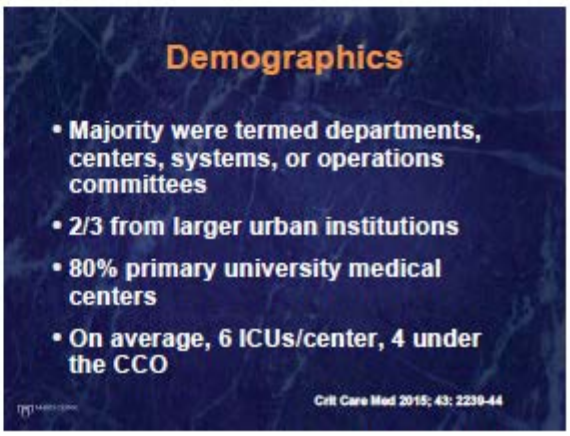






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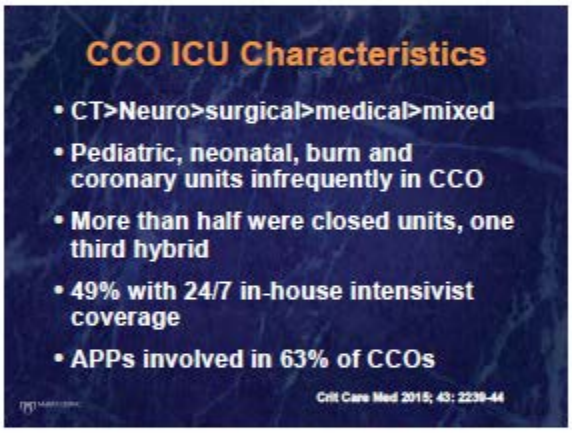


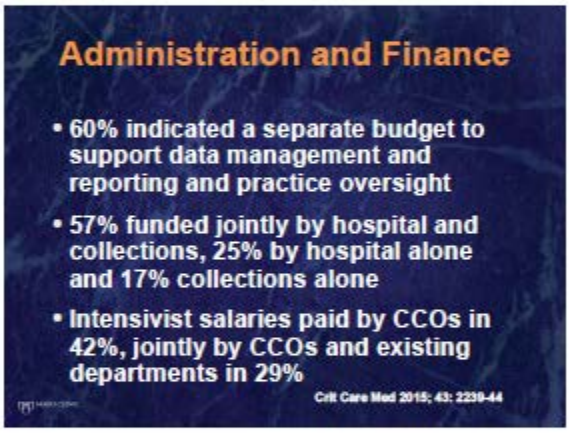


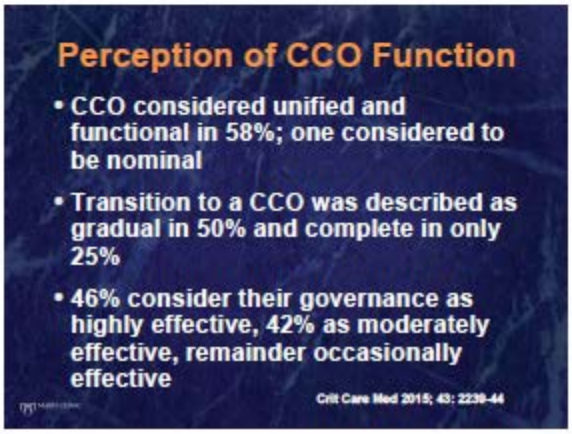


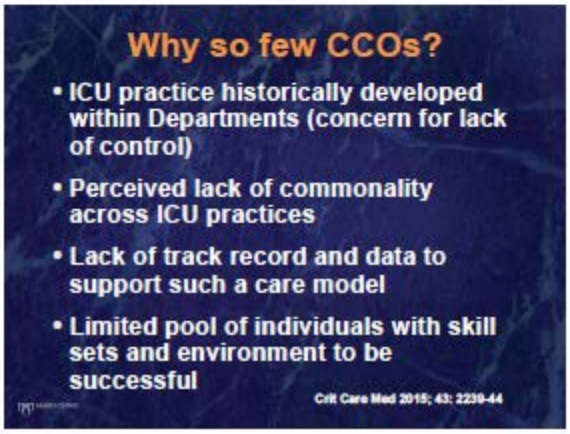

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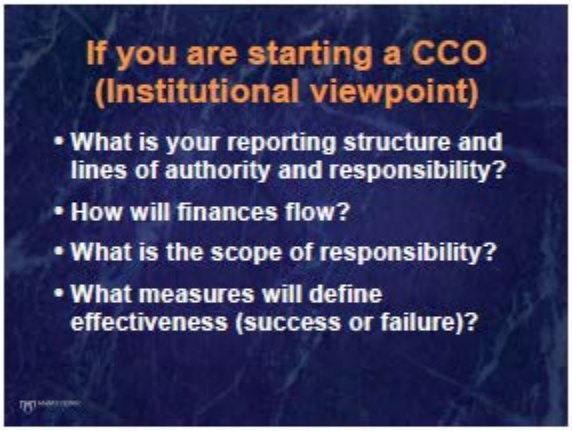



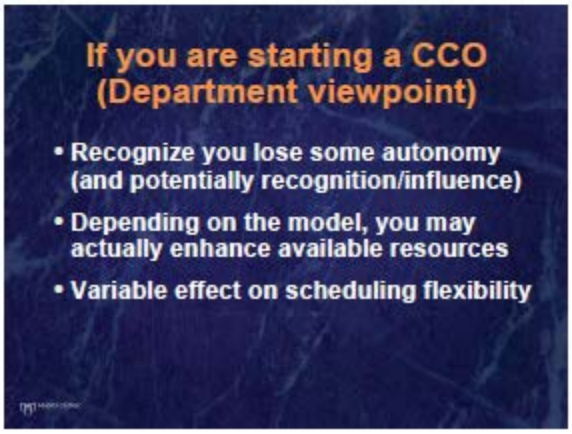


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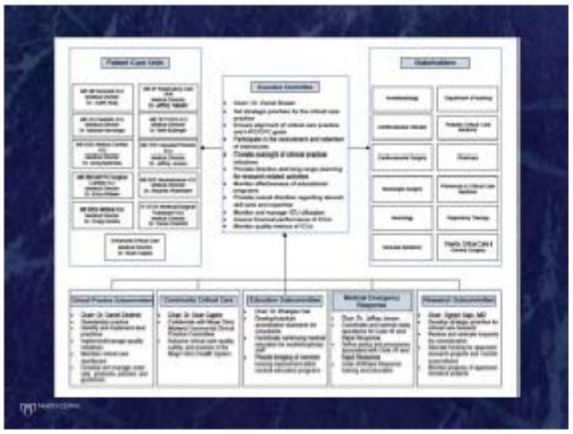
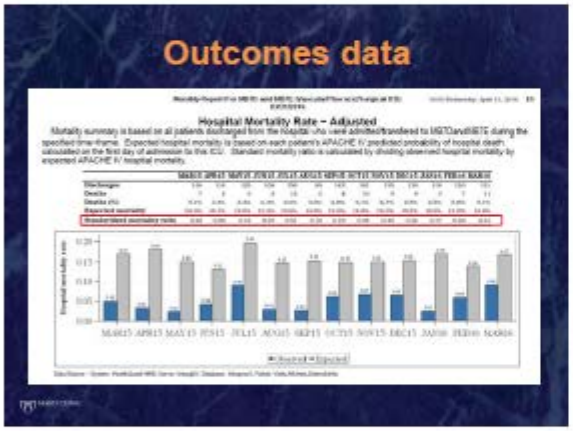
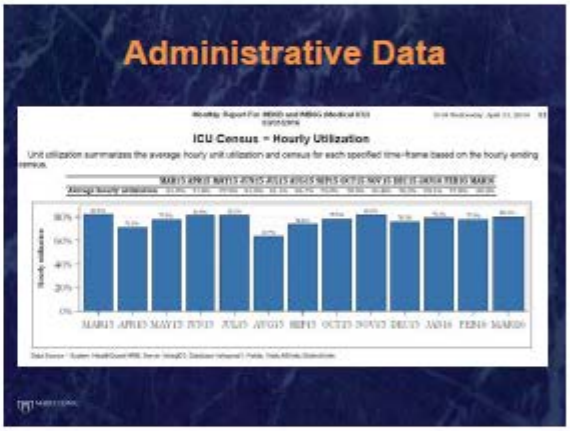
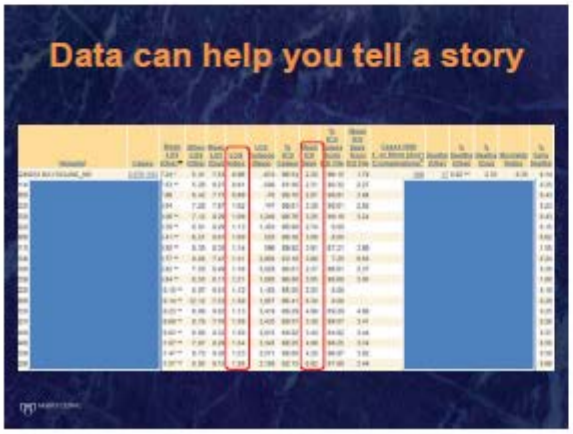
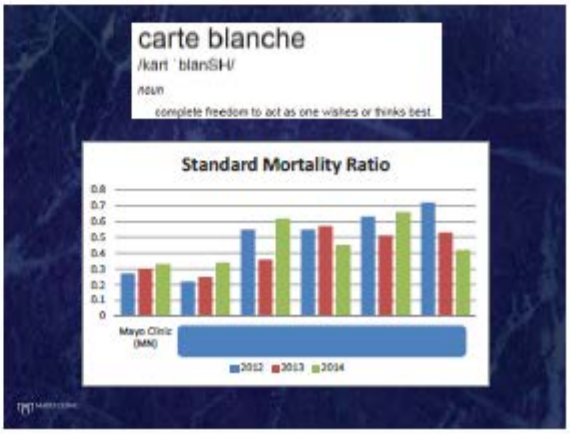


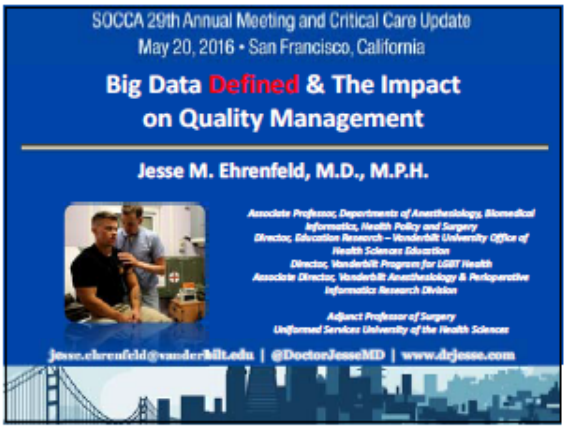



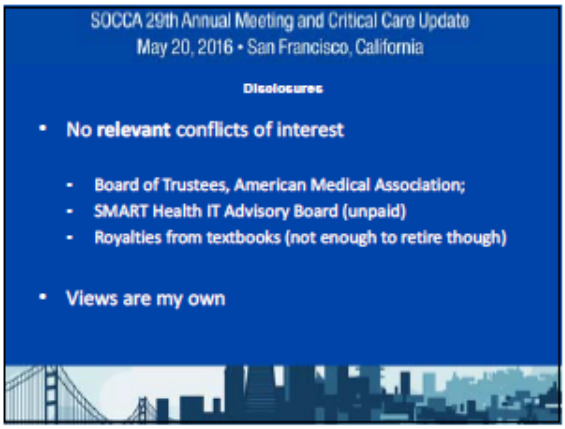
# Speaker Presentations

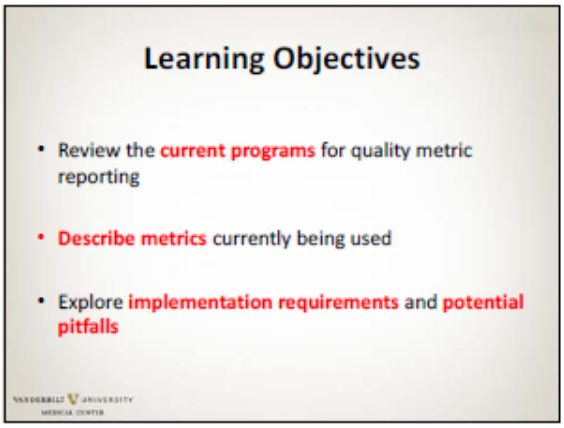
**Critical Care Organizations in Academic Medical Centers**
Daniel R. Brown, MD, PhD, FCCM

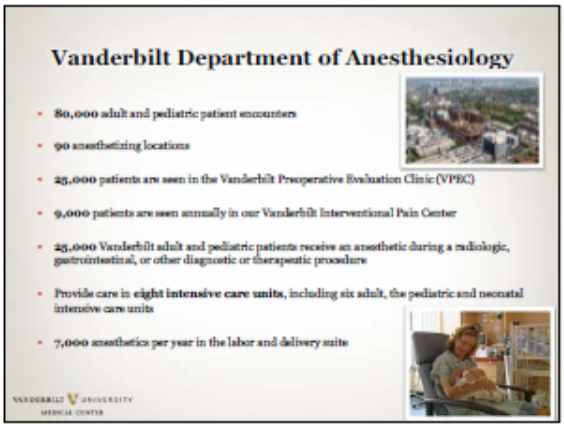

# Speaker Presentations

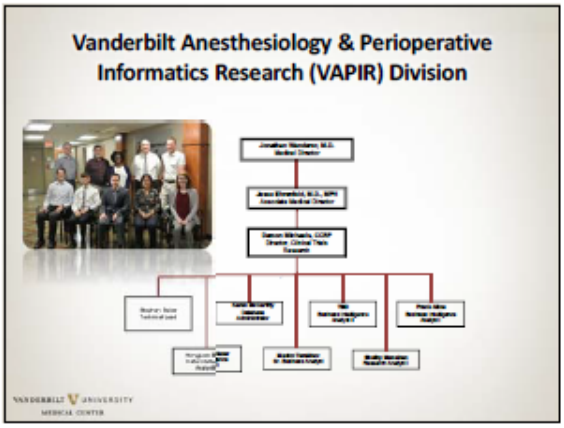
**Big Data Defined: What Does It Really Mean for Quality Management in the ICU**
Jesse M. Ehrenfeld, MD, MPH

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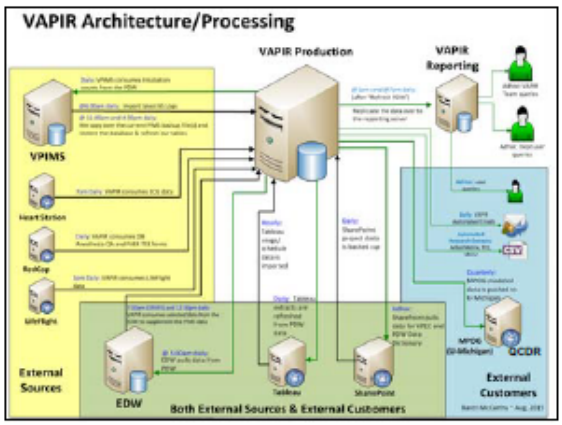
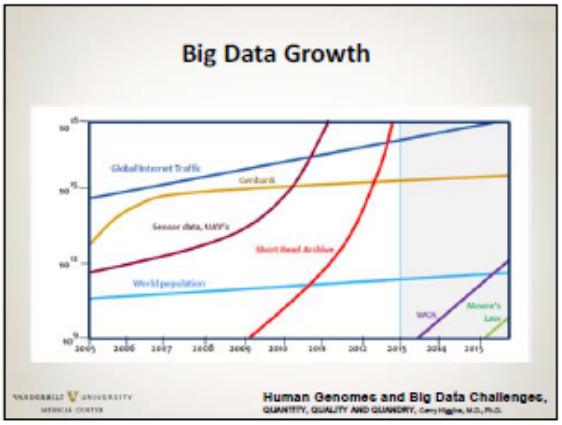
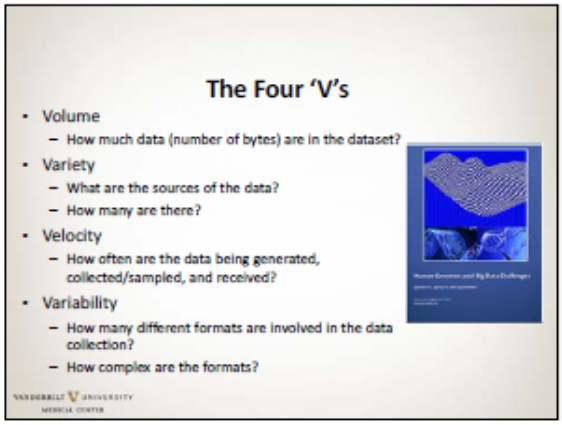
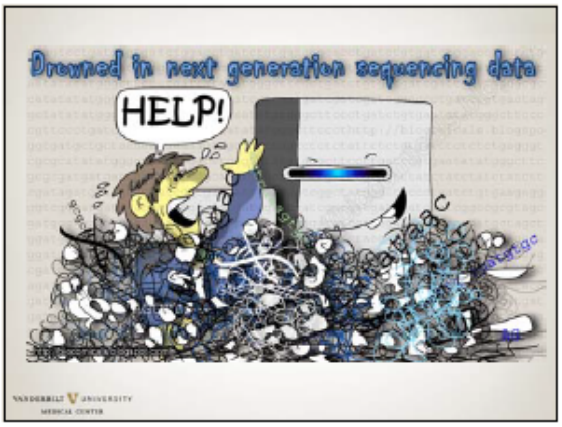
**Big Data Defined: What Does It Really Mean for Quality Management in the ICU**
Jesse M. Ehrenfeld, MD, MPH

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**Challenges in the Use of Big Data in the ICU**
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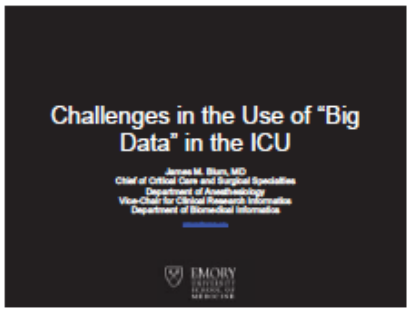






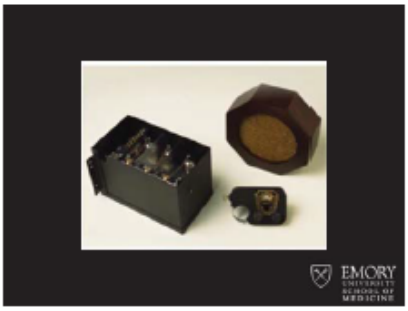




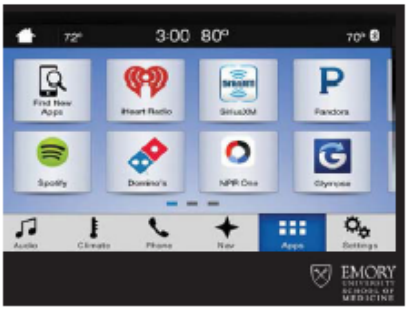


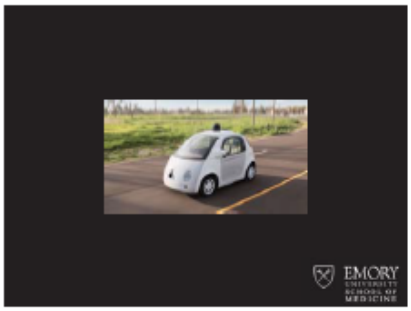


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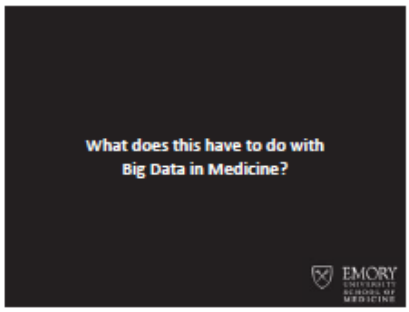



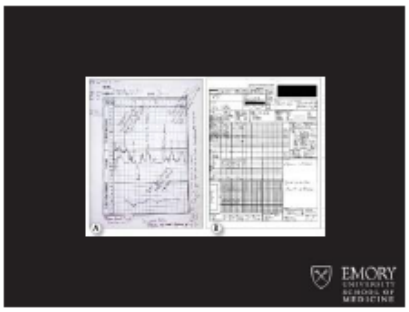


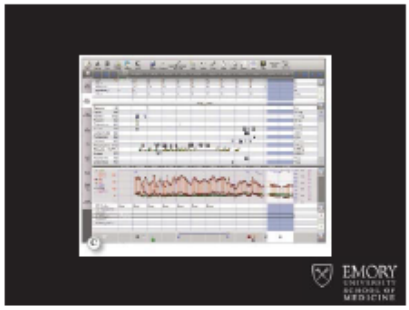





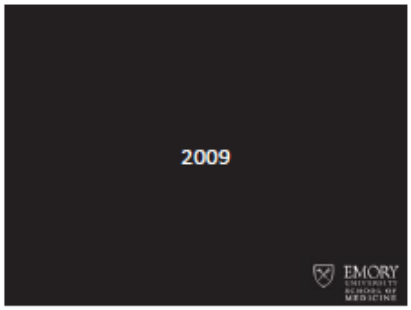




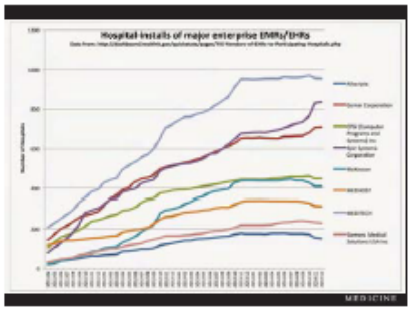

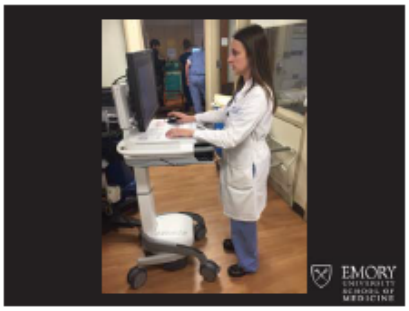

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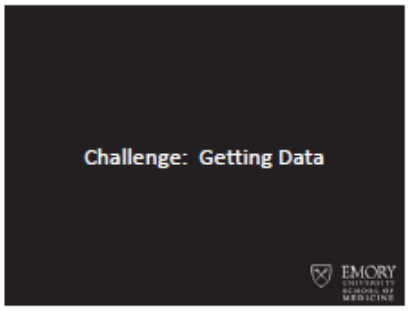


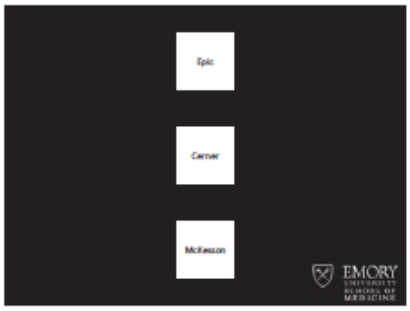


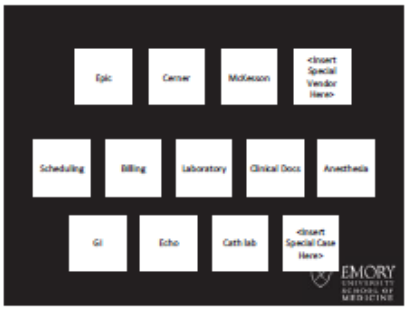


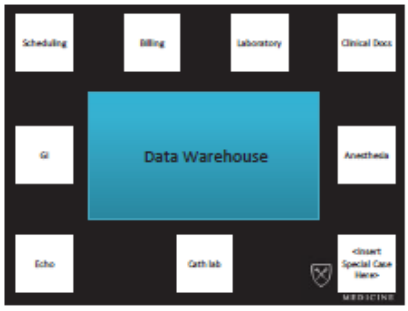


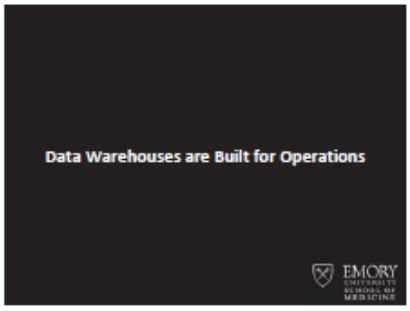


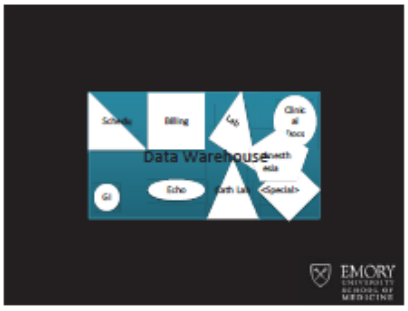





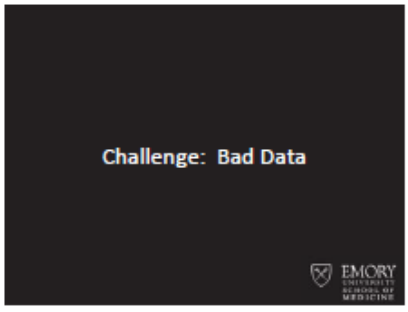


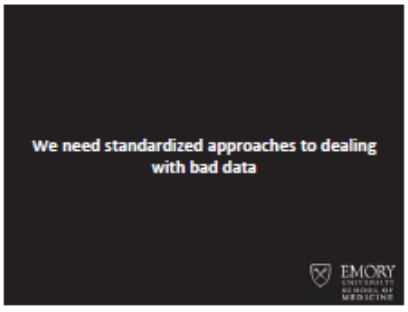

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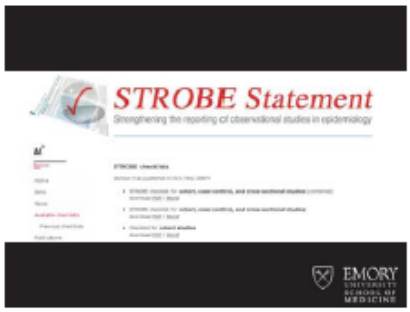



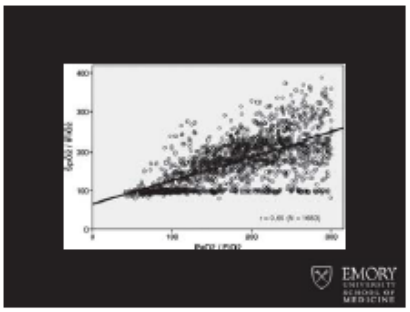


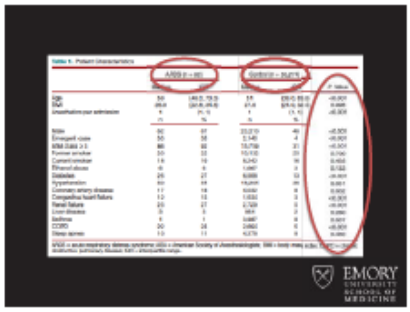


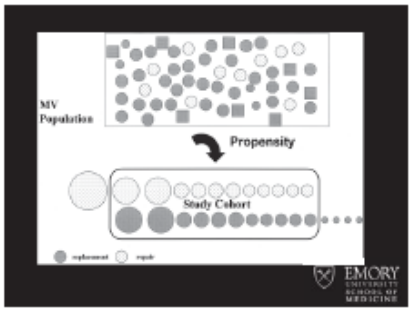


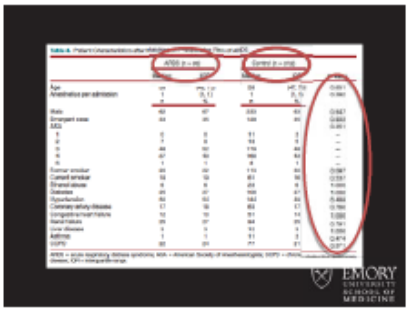



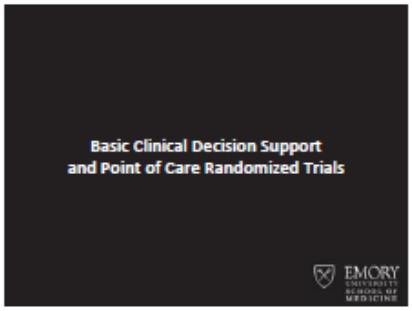


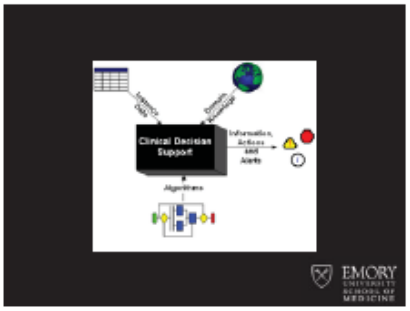


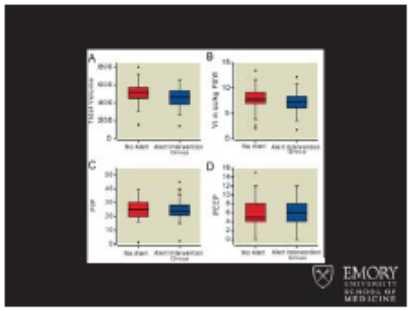



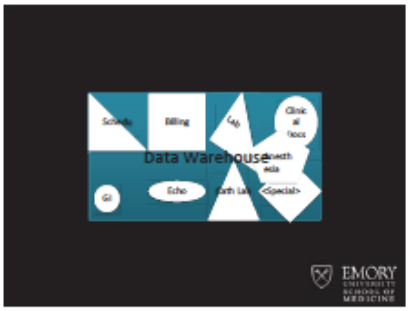

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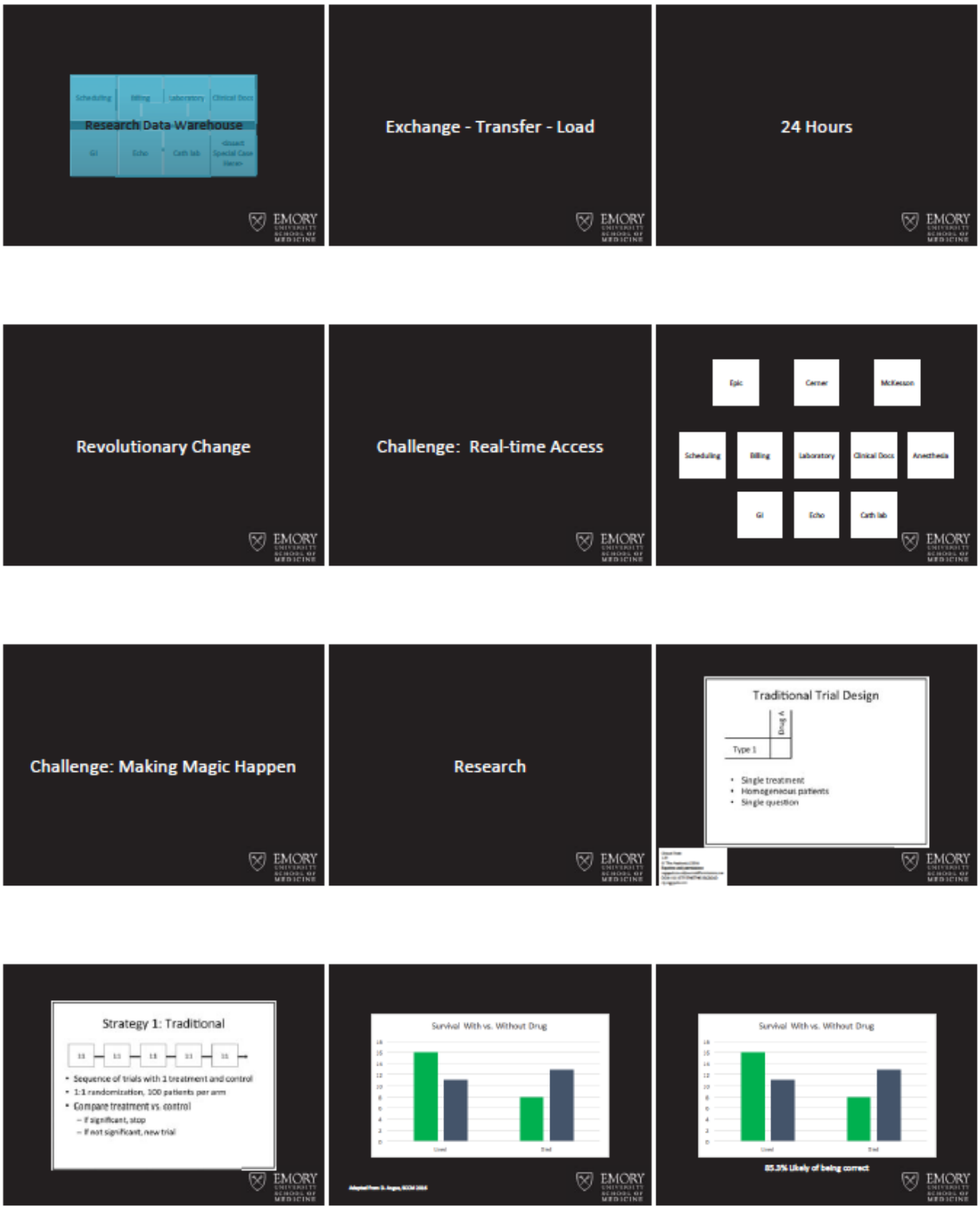

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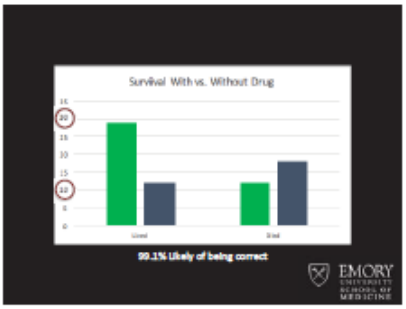



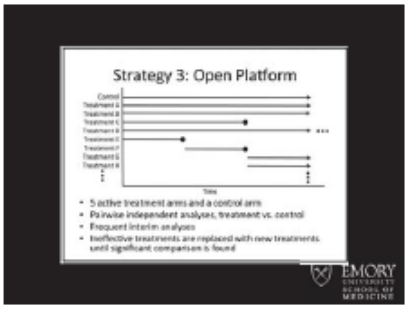




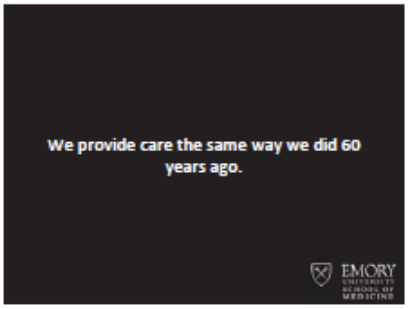


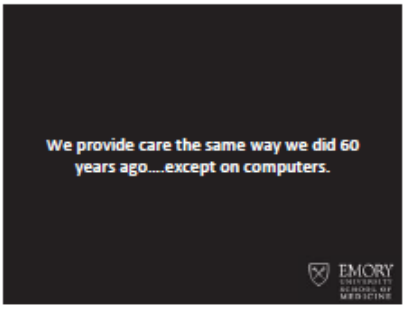



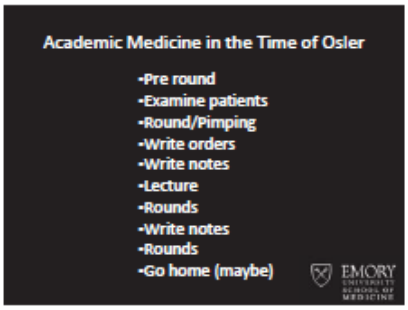


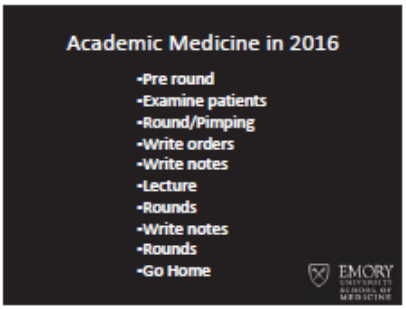

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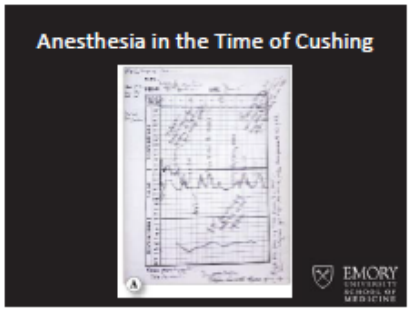
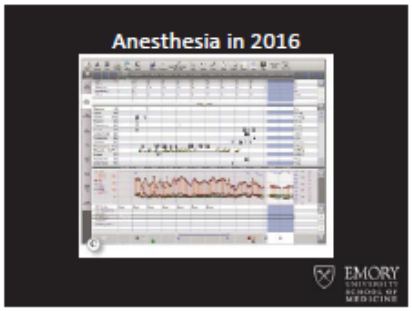
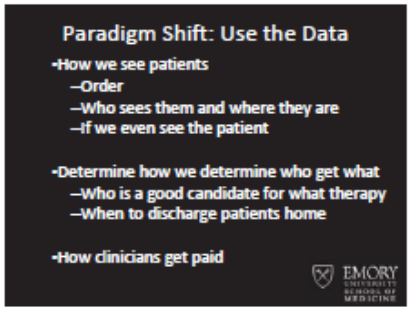
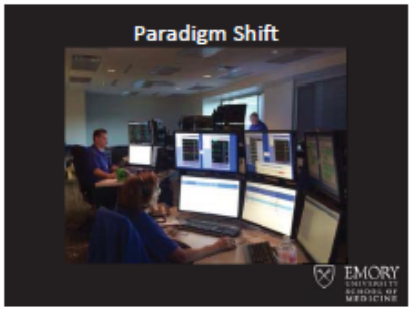
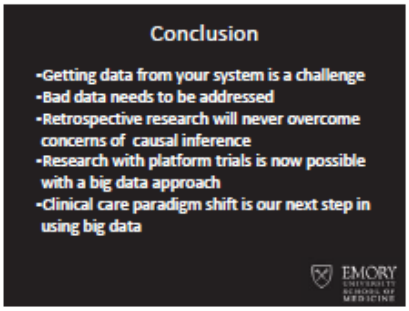


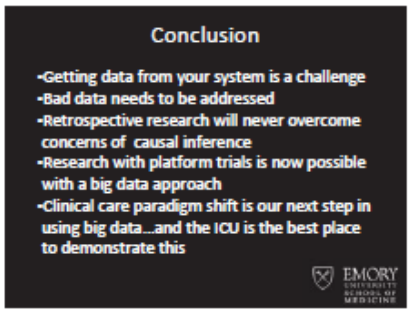








# Speaker Presentations

**MIMIC-2 Project**
Daniel S. Talmor, MD

SOCCA 29th Annual Meeting and Critical Care Update
May 20, 2016 • San Francisco, California

**Publically Available Databases at BIDMC and MIT**

Daniel Talmor MD, MPH
Anesthesia, Critical Care and Pain Medicine

SOCCA 29th Annual Meeting and Critical Care Update
May 20, 2016 • San Francisco, California

**Disclosures**

Funding-
NIH
Gordon and Betty Moore Foundation

Lectures
Hamilton Medical

Scientific Advisory Board
Intensix

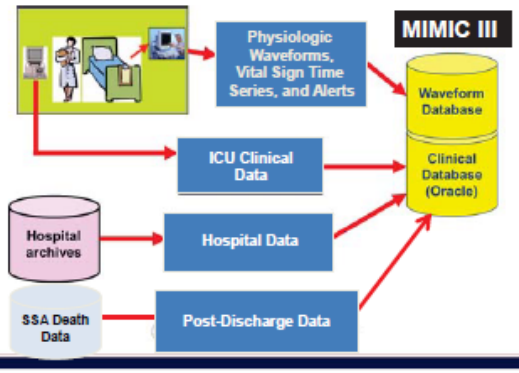
## Agenda

- MIMIC-III (Medical Information Mart for Intensive Care III)
- eICU Research Institute (eRI) overview
  - eRI - MIT Collaboration
  - Sampling strategy
- Access and Use
- The people who make it happen

## MIMIC-III

- A large, freely-available database with de-identified health-related data
- > 40,000 stays in ICUs from Beth Israel Deaconess Medical Center between 2001 and 2012.
- Data collected from two different EMRs
  - 2001 to 2008- Careview
  - 2008 to 2012- MetaVision

## MIMIC III Data Acquisition

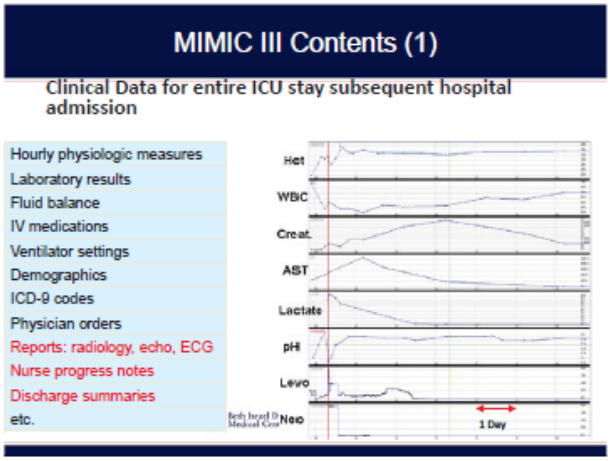


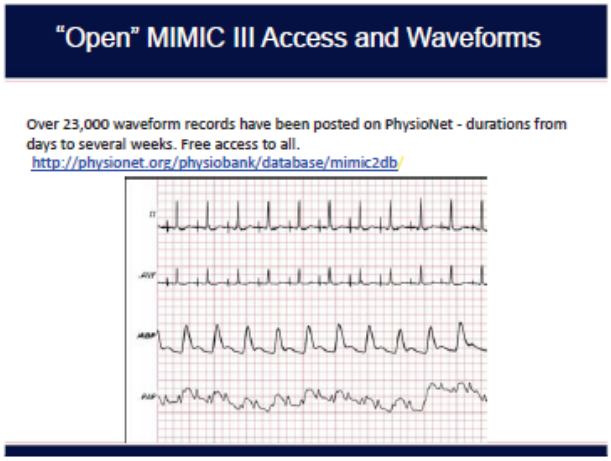

## MIMIC III database includes:

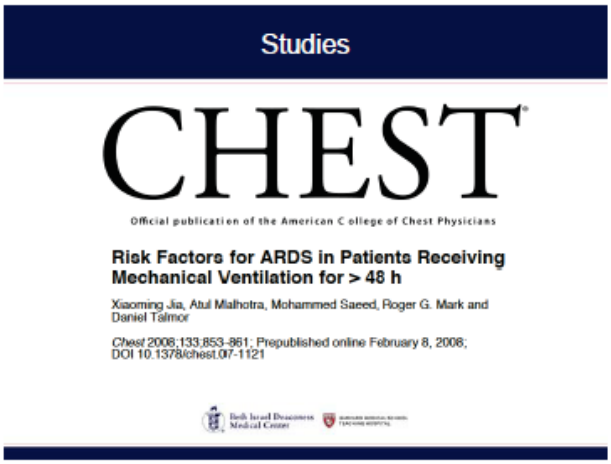
- Demographics
- Vital sign measurements at the bedside (~1 data point per hour)
- Laboratory test results
- Procedures
- Medications
- Caregiver notes (deidentified)
- Imaging reports (deidentified)
- Mortality (both in and out of hospital)

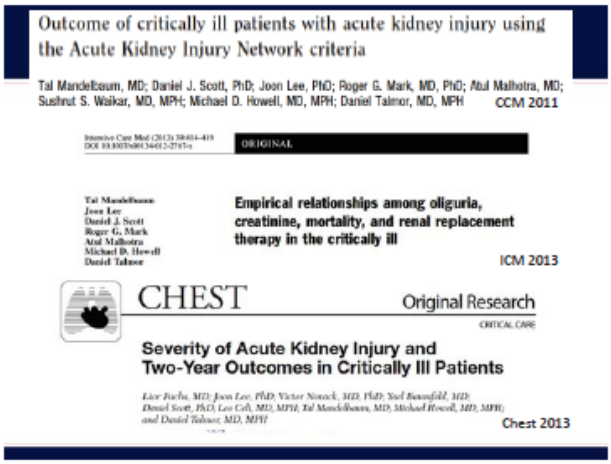
# Speaker Presentations

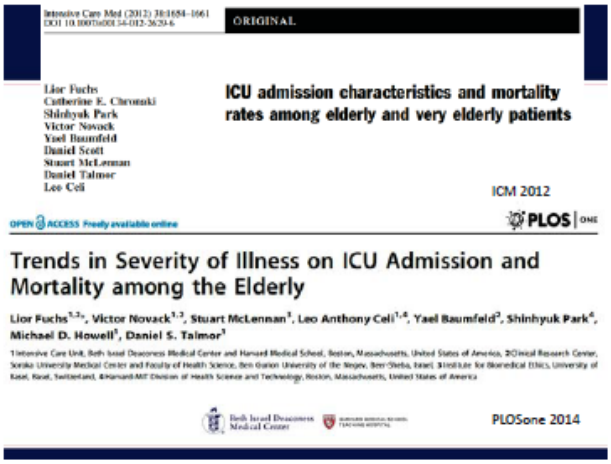
**MIMIC-2 Project**
Daniel Talmor MD, MPH

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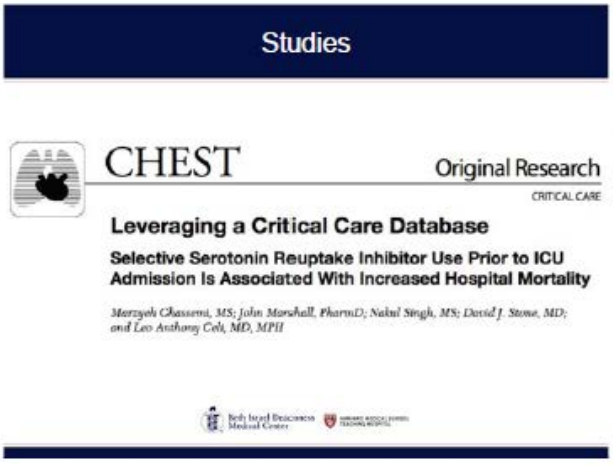
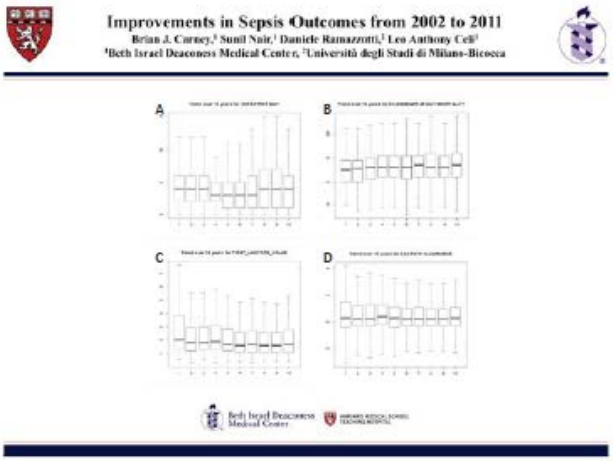
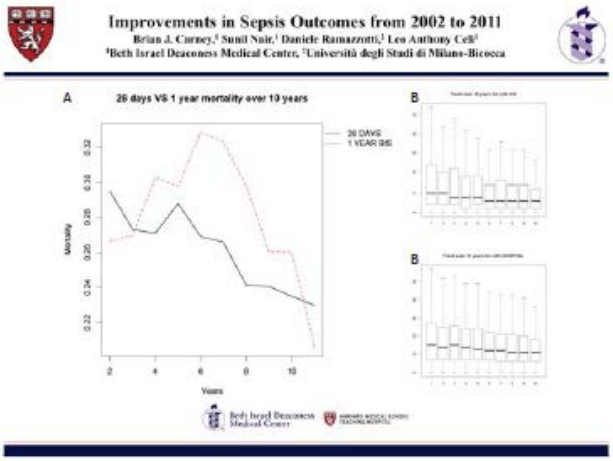
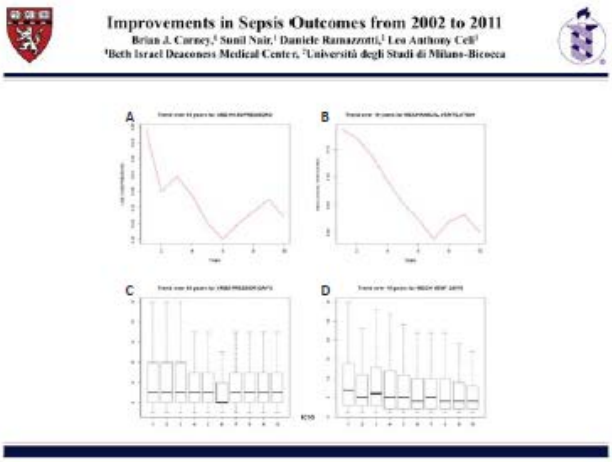
**MIMIC-2 Project**
Daniel Talmor MD, MPH

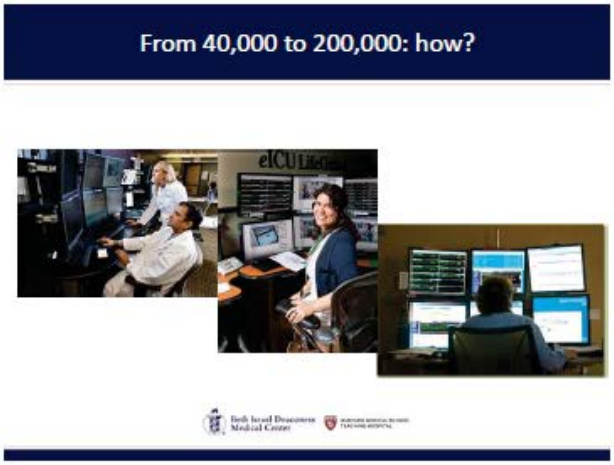






# Speaker Presentations

**MIMIC-2 Project**
Daniel Talmor MD, MPH

## eRI – Database Description

- >400 Hospitals, >800 ICUs, >40 US States, 2003-ongoing
- ~4 million ICU patient stays and growing ~500,000 per year
- > 800 million lab values
- Over 100 million medication orders
- Over 2.8 Billion vital sign measurements
- 80% 'periodic' data (eg. every 5 minute)

## eRI – Analytics towards

- eRI Database undergoes extremely thorough independent statistical analysis to confirm minimal risk of re-identification
  - Analyzed by world renowned privacy experts (Dr. Latanya Sweeney & Privacert)
  - Data schema analyzed against publically available data
  - Re-certified every year

## eRI: Proven Resource and Ready for Use

- 11 peer reviewed published manuscripts
- 7 studies in manuscript preparation/submission process
- 1 large sepsis study in progress

## Solution for further mining: eRI - MIT Collaboration

Representative subset of the total eRI data, fully deidentified, available for open access

- ~200,000 patients
- Open access to MIT-eRI dataset will be designed to support 'crowd sourcing'
- Free use by the general public, with support provided by MIT

## Access Pearls

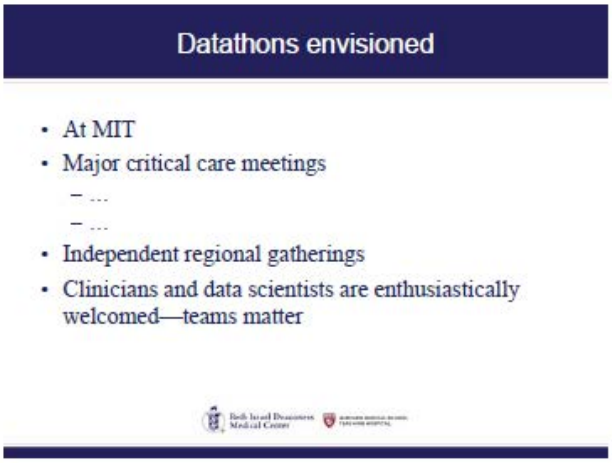
- Data use agreement—not allowed to reverse engineer and attempt patient identification
- CITI training required
- Publications require code-sharing for transparency and reproducibility
- User guide to encourage crowdsourcing

## Datathon Model


A new research model that brings together required experts from different fields in a venue that espouses constructive collaboration, group learning, error checking, and methodological review during the initial design and subsequent phases of research.

# Speaker Presentations

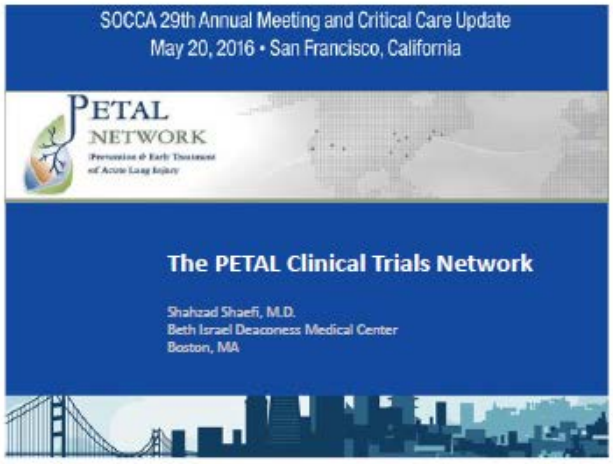
**MIMIC-2 Project**
Daniel Talmor MD, MPH

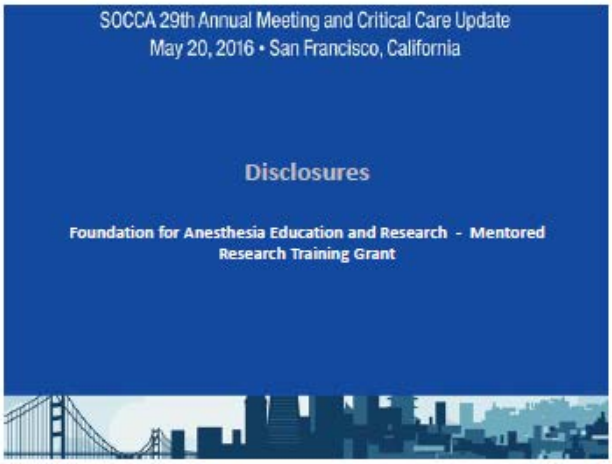




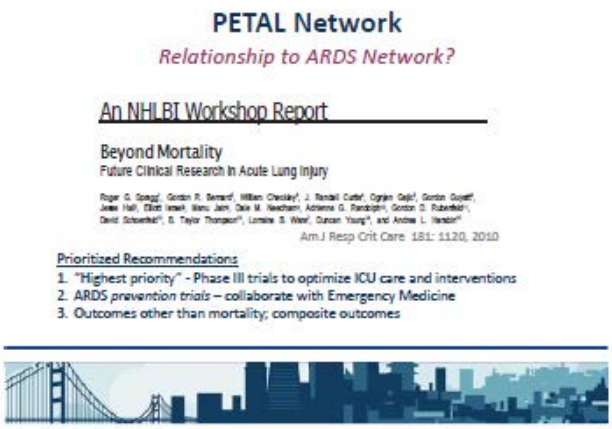
# Speaker Presentations

**The PETAL Clinical Trials Network**
Shahzad Shaefi, MD









# Speaker Presentations

**The PETAL Clinical Trials Network**
Shahzad Shaefi, MD

## PETAL Network GOALS

1. Complete 3-5 Phase III clinical trials of promising interventions for PREVENTION or EARLY treatment for patients with or at risk for ARDS
2. Establish and utilize a central IRB
3. Collect and bank high quality biospecimens for molecular definitions of illness, recovery, and susceptibility

## PETAL Network Applications

Each required to:

- Propose 2 trials
- Demonstrate ability to enroll 40 patients/year

12 PETAL Clinical Centers and a Coordinating Center
~ 44 hospitals (LA, OR, ME, VA, MS)

## Clinical Centers

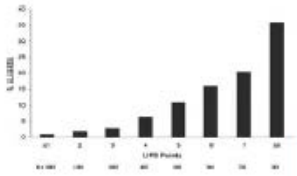
- Vanderbilt – Todd Rice, Wes Self
- Southeast – Peter Morris, Chad Miller
- Massachusetts – Jay Steingrub, Peter Hou
- California – Michael Matthay, Greg Hendey
- Ohio – Duncan Hite, Tom Terndrup
- Pittsburgh – Don Yealy, Derek Angus
- Denver – Marc Moss, Adit Ginde
- Univ Washington – Terri Hough, Ellen Bulger
- Utah – Colin Grissom, Todd Allen, Alan Morris
- Boston – Dan Talmor, Nate Shapiro
- Michigan – Bob Hyzy, Pauline Park
- Montefiore-Sinai – Michelle Gong, Lynne Richardson

## Prevention Trials

*Challenges*

- Who is at risk for ARDS?
- Lower mortality in patients at-risk for ARDS
  - Huge enrollment necessary to demonstrate small absolute differences in mortality
  - Resources?

## Single center prospective evaluation of patients with bilateral opacities presenting to the ED



Gajic, AJRCCM 2010

| EALI Score | (0 to 4 pts) |
|---|---|
| 1 $O_2$ requirement | |
| > 2-6 L/min 2 pts | (1 pt) |
| > 6 L/min | (2 pt) |
| 2. Respiratory Rate > 30 | (1 pt) |
| 3. Immune suppression | (1 pt) |

| Model | Sensitivity | Specificity | PPV | NPV |
|---|---|---|---|---|
| EALI score ≥ 2 | 96% | 76% | 47% | 98% |
| LPIS > 4 | 97% | 37% | 33% | 97% |
| LPIS > 6 | 81% | 70% | 48% | 92% |

## Prevention and Early Treatment

*Challenges*

- 1995 ARMA: ARDS Network Lower Tidal Volume Trial
  - 861 subjects necessary to demonstrate a reduction from 50% to 40%
- Established ARDS – Mortality ~30%
  - ~1800 subjects needed to demonstrate a 20% relative reduction in mortality (to 24%).
- At risk for ARDS – Mortality ~15%
  - ~4,000 subjects needed to demonstrate a 20% relative reduction in mortality (to 12%)
  - PETAL Network funded to enroll 2,640 patients, total

# Speaker Presentations

**The PETAL Clinical Trials Network**
Shahzad Shaefi, MD

## PETAL Status

- Funded July 2014 for 7 years
- First meeting June, 2014
- Biweekly webinars
- Many committee meetings
- Twice yearly in-person meetings
- SC developing protocols
- Began enrollment in 2015

## NIH PETAL Network Trials

October, 2015

- Moving Forward
  - Neuromuscular blockade in established ARDS
- Under Consideration
  - Vitamin D
  - Lower tidal volume ventilation in at-risk patients
  - No sedation in mechanically ventilated patients
  - HFNC vs NIV
  - Azithromycin
  - Others

PETAL NETWORK
Prevention & Early Treatment of Acute Lung Injury

## Reevaluation Of Systemic Early neuromuscular blockade: ROSE

Principal Investigators: Moss and Angus

## The French Trials

- ARDS with P/F < 150[1]
- Cisatracurium x 48 hours, vs placebo

| Trial | N | # ICUs | Primary outcome + result | Year |
|---|---|---|---|---|
| Gainnier et al | 56 | 4 | Improved oxygenation over 5 days | 2004 |
| Forel et al | 36 | 3 | Decreased pulmonary and serum proinflammatory cytokine levels at 48 hours | 2006 |
| **ACURASYS** | **340** | **20** | **Improved adjusted 90d survival<br>No difference in muscle weakness** | **2010** |

[1]EXCEPT 2006 trial

## Why conduct the ROSE trial?

- Adoption of NMB low in the US despite:
  - High profile publication
  - Purported mortality reduction with relatively simple intervention
- Potential reasons for low adoption:
  - Concerns that study not adequately robust
    - Borderline statistical significance (p = 0.08 unadjusted)
    - Underpowered according to the authors
  - KM curve separates at Day 18 in regard to mortality
  - Difficult to adopt NMB when trend is toward lighter sedation
  - Concern about assessment of neuromuscular function
  - Lack of replication, call for validation
- Significant benefit to replication:
  - NMB would have high grade evidence level
  - ROSE studies answers complementary questions

## Key Issues in the ROSE Study Design

- Inclusion criteria, S/F ratio, and timing of inclusion
- NMB agent, titration, duration of infusion
- PEEP protocol
- Sedation
- Proning
- Protocolization vs. practicality
- Mechanism of action: How to measure ventilator dyssynchrony
- Long term outcomes
- Feasibility

# Speaker Presentations

**The PETAL Clinical Trials Network**
Shahzad Shaefi, MD

## Rose Study Protocol

- Inclusion Criteria
  - Presence of all of ARDS Berlin Criteria for < 48 hours
    - PaO2/FiO2 < 150 with PEEP > 8 cm H2O
      OR
    - SaO2/FiO2 ratio that correlates with a PaO2/FiO2 < 150 for > 30 minutes at a PEEP > 8 cm H2O
  - Endotracheal ventilation for < 5 days (120 hours)
- Intervention (not blinded)
  - Patients randomized to intervention (routine NMB use)
    - Cisatracurium bolus of 15 mg followed by an infusion of 37.5 mg/hour for 48 hours.
    - defined stopping criteria
  - Control arm (no routine NMB use)
    - NMB will be allowed if needed

## Rose Study Protocol

- Primary endpoint
  - 90d mortality prior to discharge home
- Secondary endpoints
  - Ventilator dyssynchrony
  - Other mortality/survival endpoints
  - In-hospital physical function assessment
  - Telephone obtained long term outcomes
- 1408 participants
  - 35% control arm mortality vs. 27% treatment arm mortality
  - 90% power, 2 sided alpha 0.05
  - 2 interim analyses at each successive 1/3 of patients enrolled

## Key Differences Between the ROSE Protocol and the Papazian Trial

- PEEP
  - High PEEP protocol
    - Papazian study used a low PEEP protocol
- Sedation
  - Control arm is targeted to lighter sedation (Ramsay 2-3)
    - Papazian study used deep sedation in control arm
- Unblinded study
  - Papazian study used a placebo control infusion
- S/F ratio can be used for hypoxemia inclusion

## ROSE Enrollment

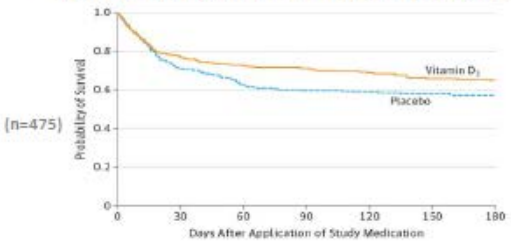
| Center | January | February | March | April | May | Total |
|---|---|---|---|---|---|---|
| ALIGNE | 4 | 7 | 3 | 8 | 0 | 22 |
| Boston | 0 | 1 | 3 | 0 | 0 | 3 |
| California | 0 | 2 | 4 | 7 | 0 | 13 |
| Denver | 7 | 4 | 2 | 3 | 0 | 16 |
| Michigan | 0 | 1 | 4 | 4 | 1 | 10 |
| Montefiore | 1 | 6 | 10 | 4 | 0 | 21 |
| Ohio | 0 | 0 | 6 | 3 | 0 | 9 |
| Pacific NW | 0 | 3 | 4 | 3 | 0 | 10 |
| Pittsburgh | 2 | 2 | 2 | 5 | 0 | 11 |
| Southeast | 1 | 2 | 5 | 3 | 0 | 11 |
| Utah | 6 | 9 | 4 | 7 | 0 | 26 |
| Vanderbilt | 0 | 4 | 5 | 2 | 2 | 13 |
| Total | 21 | 41 | 51 | 49 | 3 | 165 |

PETAL NETWORK
Prevention & Early Treatment of Acute Lung Injury

Vitamin D to Improve Outcomes by Leveraging Early Treatment
VIOLET

Principal Investigators: Ginde and Talmor

## Vitamin D3 540K IU in Mixed ICU Patients




6 mo mortality: HR 0.78 (0.58-1.04); p=0.09
No hypercalcemia or vitamin D-related SAEs

Amrein et al JAMA 2014

# Speaker Presentations

**The PETAL Clinical Trials Network**
Shahzad Shaefi, MD

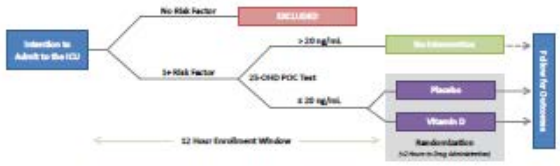
## Why conduct the VIOLET trial?

- Strong prior data to support mechanism, dosing, safety, and candidates that will likely benefit
- Confirm Amrein findings in large phase III trial
  - Focus on higher risk subset of ICU patients
  - Use PETAL infrastructure for early intervention
- Pre-ICU recruitment is feasible and desirable
- Simple, safe intervention with minimal data collection
  - Lower cost
  - Much larger source population available
  - Generalizable results that can be rapidly disseminated

## Trial Concept

- Population: Adult patients in ED, ward, or OR going to ICU with 1+ high risk conditions and vitamin D deficiency
- Intervention: Single enteral dose of 540K IU vitamin D3
- Primary Endpoint: All cause, all location 90 day mortality
- Secondary Endpoints
  - Clinical: Hospital LOS, Facility LOS, VFD
  - Physiological: ARDS, organ failure severity, 25OHD, IL-6
  - Safety: Hypercalcemia, kidney stones, fractures, SAEs
- Sample Size: Max N=2128 (85% power, 5% absolute Δ)

## Trial Schematic




## Key issues discussed by VIOLET committee

- Inclusion criteria, POC test, timing of recruitment
- Primary outcome
- Streamlined data collection
  - ARDS assessment
  - Long-term outcomes
  - Biospecimen collection
- Observational (non-randomized) cohort
- Consent issues
- Sample size and stopping rules
- Feasibility

## Risk Factors (Mortality/ARDS)

**Direct**

- Pneumonia
- Aspiration
- Smoke inhalation
- Lung contusion
- Mechanical ventilation (anticipated duration >24 hours)

**Indirect**

- Shock
- Severe Sepsis
- Pancreatitis

## Intention to Admit to ICU

- Consistent with Amrein trial
- Allows for early (pre-ICU) randomization
  - Most (>90%) will end up in ICU
  - Values early recruitment over perfect ICU admits
- Higher risk patients and easier to implement than LIPS
- Time zero defined to be flexible but similar timing of recruitment across sites

# Speaker Presentations

**The PETAL Clinical Trials Network**
Shahzad Shaefi, MD

### Secondary Vitamin D Screening

- Select population most likely to benefit
- Consistent threshold with Amrein trial
- Supports safe use of high dose intervention
- Simple to implement and disseminate

### Feasibility—Are there enough patients?

- Larger source population than ARDS treatment trials
- Clinical centers average ~4,000 ED to ICU admits/year
- Conservatively 800 (20%) will be eligible for VIOLET
  - 40% meet initial inclusion/exclusion criteria
  - 50% vitamin D deficient
- Randomize 60 (7.5% of eligible) per Center per year
  - Would finish trial in 3 years
- Plus add in hospital ward and OR patients

### Feasibility—Is the trial simple enough?

- Most effort is screening and recruitment
- Single dose enteral study drug
- Single baseline blood draw
  - Except first 200 patients receive day 3 blood draw
- Limited follow up data collection
  - No required additional touchpoints
  - Limited/remote in-hospital safety monitoring
  - Single chart review for endpoints after hospitalization
  - Brief 90 day phone call for efficacy/safety endpoints

PETAL NETWORK
Prevention & Early Treatment of Acute Lung Injury

**Thank you!**

# Speaker Presentations

**A Novel Association Between High Density Lipoprotein Levels and the Risk of Acute Kidney Injury after Cardiac Surgery**

Loren E. Smith, MD, PhD

## A Novel Association Between High Density Lipoprotein Levels and the Risk of Acute Kidney Injury After Cardiac Surgery

Loren E. Smith, MD, PhD
Derek K. Smith, DDS
MacRae F. Linton, MD
Frederic T. Billings IV, MD, MSc

VANDERBILT UNIVERSITY MEDICAL CENTER

## Disclosures

No commercial interests to disclose

Funding Sources:
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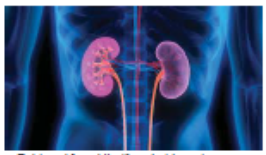
LES T32GM108554,
FTB K23 GM102676 and R01GM112871
UL1 TR000445

Vanderbilt University Medical Center
Department of Anesthesiology

## Postoperative Acute Kidney Injury (AKI)

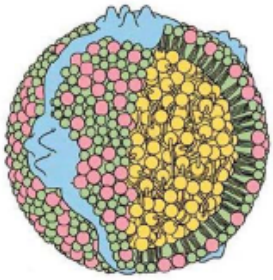
- Occurs in up to 30% of cardiac surgery patients
- Increased risk of future dialysis, progression of chronic kidney disease, and death



Retrieved from http://trendsvid.com/wp-content/uploads/2015/12/Kidney-Disease.jpg

## Mechanisms of AKI

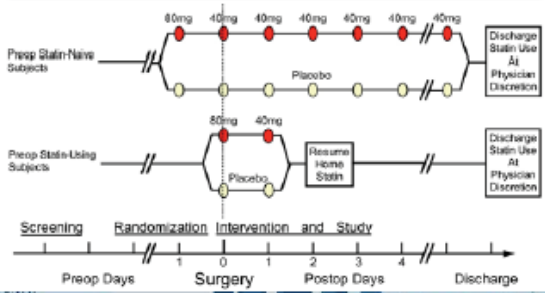
- Inflammation
- Oxidative stress
- Endothelial dysfunction
  - Renal ischemia



## Hypothesis

A high preoperative HDL cholesterol concentration is associated with a reduced risk of postoperative AKI.

## Statin AKI Cardiac Surgery RCT



# Speaker Presentations

**A Novel Association Between High Density Lipoprotein Levels and the Risk of Acute Kidney Injury after Cardiac Surgery**

Loren E. Smith, MD, PhD

## Study Participants (n=391)

| | |
|---|---|
| Age (years) | 67 (50, 81) |
| Male | 265 (67%) |
| Preoperative statin use | 244 (62%) |
| Perioperative Atorvastatin treatment | 200 (51%) |
| BMI (kg/m²) | 27.5 (22.6, 36.7) |
| History of diabetes mellitus | 123 (31%) |
| HDL (mg/dL) | 36 (25, 54) |
| eGFR (mL/min/1.73m²) | 72.8 (40.0, 97.4) |
| Valve surgery | 251 (64%) |
| Cardiopulmonary bypass time (min) | 108 (0, 211) |
| Intraoperative red blood cell transfusion (units) | 0 (0, 4) |

50th (10th, 90th) percentile

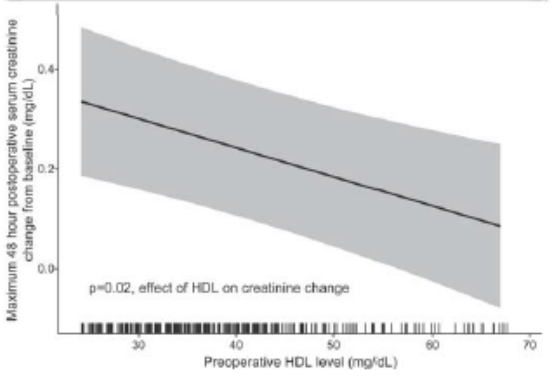
## Statistical Analysis

We built a two-component mixture model to analyze the association between preoperative serum HDL concentration and maximum change in serum creatinine between baseline and postoperative day 2.

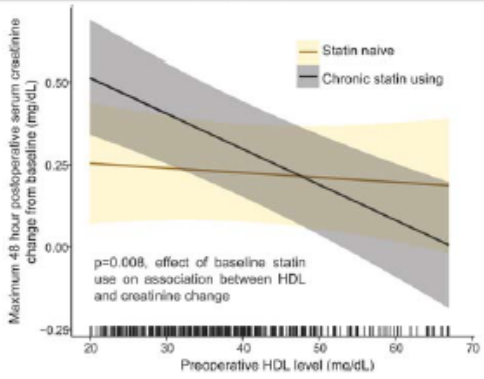
Covariates:

- Age
- Sex
- Body mass index
- Diabetes mellitus
- Baseline estimated glomerular filtration rate (eGFR)
- Valve surgery indicator
- Intraoperative red blood cell transfusion volume
- Intraoperative volume of hydroxyethyl starch administered

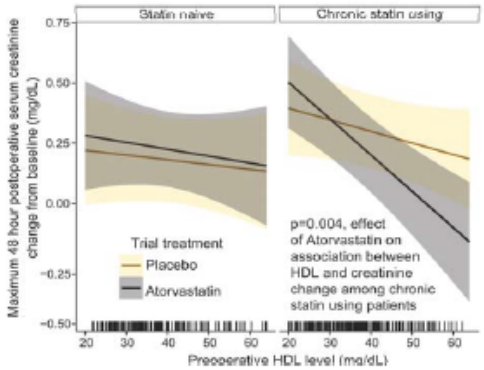
## Preoperative HDL level vs. postoperative serum creatinine change



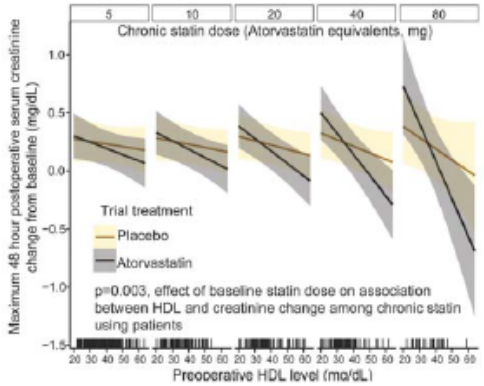

## Chronic statin use modifies the association between HDL and serum creatinine change.




## Perioperative atorvastatin modifies the association between HDL and serum creatinine change among chronic statin users




## Dose of chronic statin also modifies the association between HDL and serum creatinine change.



# Speaker Presentations

**A Novel Association Between High Density Lipoprotein Levels and the Risk of Acute Kidney Injury after Cardiac Surgery**

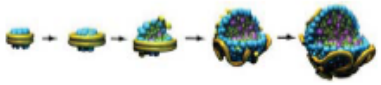
Loren E. Smith, MD, PhD

## Conclusions

- Higher preoperative HDL cholesterol concentration is associated with a decreased risk of AKI after cardiac surgery.
- Chronic statin using patients with higher HDL levels have less postoperative serum creatinine rise, an effect which is accentuated with higher chronic statin dose and perioperative atorvastatin therapy.

## Future Directions

- Preoperative HDL level and AKI
  - Anti-inflammatory and anti-oxidant capacity of trial patients' HDL
- Statin interaction with HDL
  - Statins may alter HDL protein composition
  - Statins may alter HDL particle distribution



Retrieved from http://www.bostonheartdiagnostics.com/science_portfolio_map_test.php

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## Questions

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# Speaker Presentations

**Cardiac**
Joseph S. Meltzer, MD

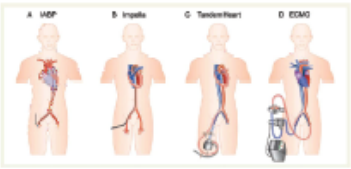
Temporary Mechanical Circulatory Support for Cardiac Emergencies

Joseph Meltzer, MD
Chief, Division of Critical Care
Department of Anesthesiology and Perioperative Medicine
UCLA

- More patients are surviving with heart failure
  - 825K new diagnoses/year
  - 5.1M Americans with CHF
- They can present with cardiogenic shock

Circulation. 2014; 129(3): e28-292

Mechanical Circulatory Support

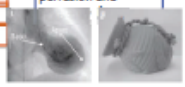



- These devices can (but don't always) aid in bridging patient to HD stability or definitive management

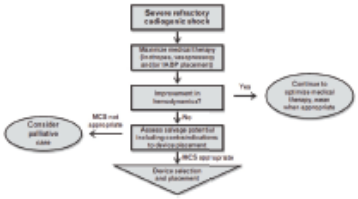
Indications for MCS

- Cardiogenic shock
  - Acute MI
  - Acute decompensated CHF
  - Myocarditis
  - Post cardiotomy
    Acute rejection post-OHT
    Takotsubo CM
- High-risk intervention
  - PCI
  - VT ablation
- BTLVAD or BTT
- Right ventricular failure

The goal of MCS is to decrease preload, decreased afterload and augment cardiac output in order to provide organ perfusion and

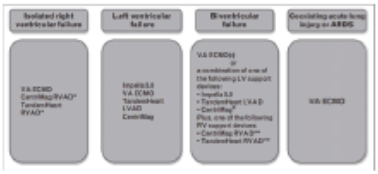


Heart Rescue Algorithm




Current Opinion in Critical Care 2012; 18: 409-416

Heart Rescue Algorithm

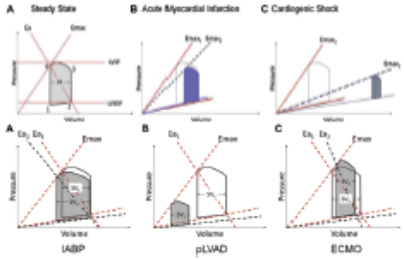



Current Opinion in Critical Care 2012; 18: 409-416

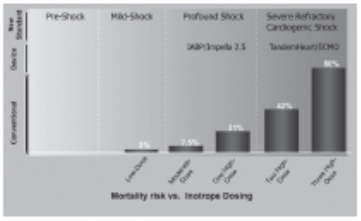
Heart Rescue Algorithm


Current Opinion in Critical Care 2012; 18: 409-416

Hemodynamic effects of MCS




Clinical Spectrum of Cardiogenic Shock




Circulation 2012; 158: 1809-1817

Hemodynamic Effects of pVAD

| | IABP | ECMO | TANDEM-HEART | IMPELLA |
|---|---|---|---|---|
| Afterload | Reduced | Increased | Increased | Neutral |
| LV stroke volume | Slight increase | Reduced | Reduced | Reduced |
| Coronary perfusion | Slight increase | Unknown | Unknown | Unknown |
| LV preload | Slightly reduced | Reduced | Reduced | Slightly reduced |
| PCWP | Slightly reduced | Reduced | Reduced | Slightly reduced |
| Peripheral tissue perfusion | No significant increase | Improved | Improved | Improved |

European Heart Journal 2014; 35; 156-67

Comparison of Devices

| | Impella 2.5 | Impella CP | Impella 5.0 | ECMO | Tandemheart | IABP |
|---|---|---|---|---|---|---|
| Mechanism | Axial/Transaxial | Axial/Transaxial | Axial/Transaxial | Centrifugal/Hybrid | Centrifugal/Hybrid | Pneumatic Counterpulsation |
| Cannula Size | 12-14Fr | 14Fr | 21-22Fr | 15-21Fr in 15-17Fr Out | 21Fr in 15-17Fr Out | 7-8F |
| CO | 2.5L/min | 3.7L/min | 5.0L/min | >4.0L/min | 4-5L/min | 0.5L/min |
| Insertion | Medium | Medium | High | Medium | High | Low |
| Puncture | No | No | No | No | Yes | No |
| Bleeding | Medium | Medium | Medium | High | High | Low |
| Implant Time | ** | ** | *** | ** | *** | * |
| Limb Ischemia | ** | 0 | *** | **** | **** | * |
| Hemolysis | *** | *** | *** | ** | ** | * |
| TTM | No | No | No | Yes | Yes | No |

F1000 Prime Reports 2014; 6: 91-99
Heart 2012; 98: 1246-1254

Simple Rules of MCS

- Continued deterioration despite increasing medications
- Initiate before arrest
- These devices can't fix poor protoplasm
- These devices are not "bad"; the patients that need them are frail

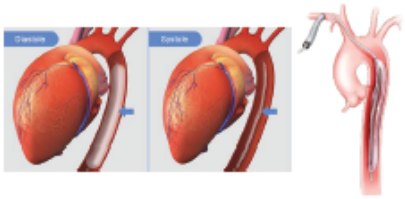
# Speaker Presentations

**Cardiac**
Joseph S. Meltzer, MD

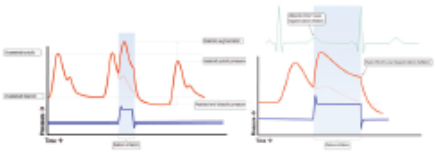
For those of you who like numbers…

- Increasing inotropes (+/- IABP) and vasoconstrictors
- Hemodynamics
  - CI>2.0
  - MAP>60mmHg
  - SBP>85mmHg
  - CVP<15mmHg
  - PAOP<20mmHg
  - End organ function: kidneys, liver, lungs, brain

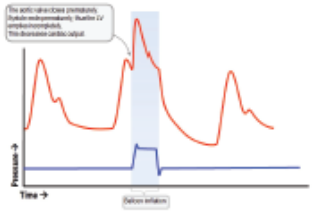
IABP - Counterpulsation



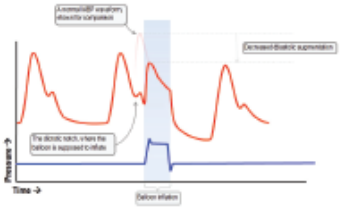
IABP - Counterpulsation



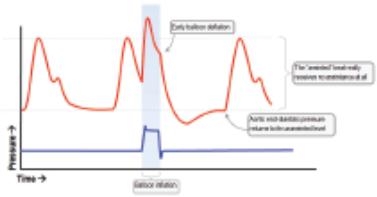
Early Inflation increased afterload



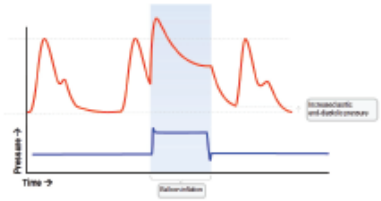
Late inflation reduces diastolic augmentation



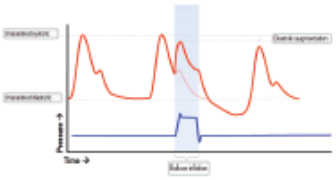
Early deflation does not reduce afterload



Late deflation increases afterload

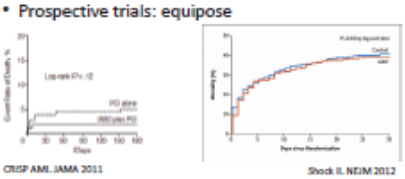


No augmentation



IABP: The Enigma

- Some patients show dramatic improvement
- Others, no effect
- Retrospective trials: benefit
- Prospective trials: equipose



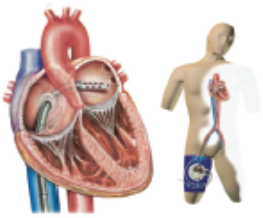
CRISP AMI. JAMA 2011 Shock II. NEJM 2012

IABP: So who should get one?

- Trials undermined by crossover, patient selection and bias
- Increased diastolic perfusion pressure does not increase coronary flow if autoregulation is intact
  - Autoregulation exhausted
- Very low diastolic BP
- Critical stenosis
- Ongoing myocardial ischemia
  - Acute MI with no-reflow
  - Cardiac surgery (good CABG + stunning)

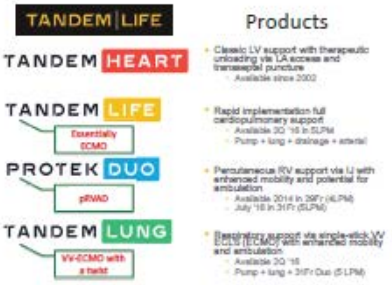
No-Reflow Phenomena

Tandem Heart

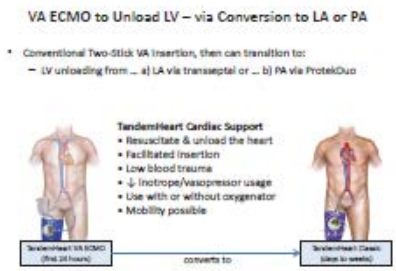


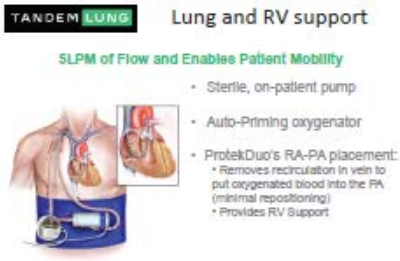
# Speaker Presentations

**Cardiac**
Joseph S. Meltzer, MD

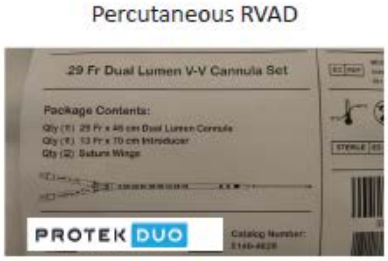


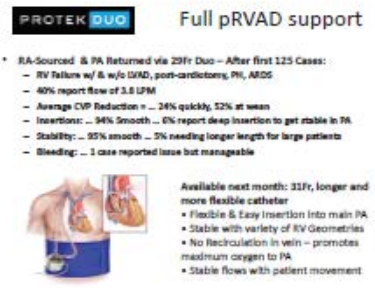


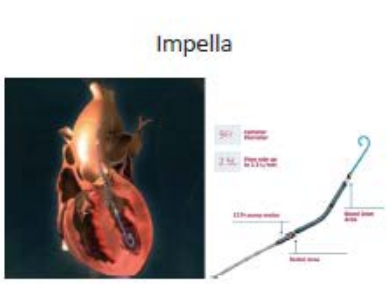


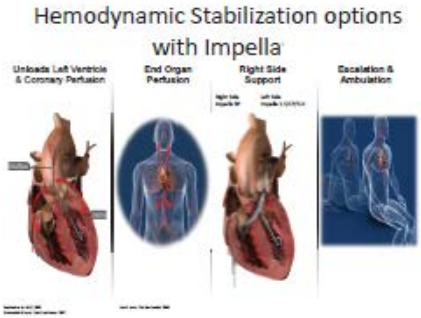



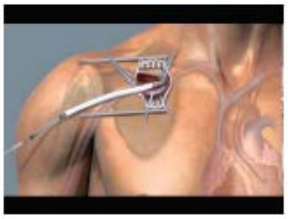


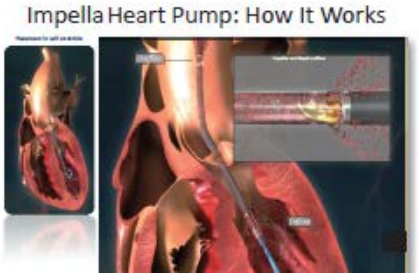


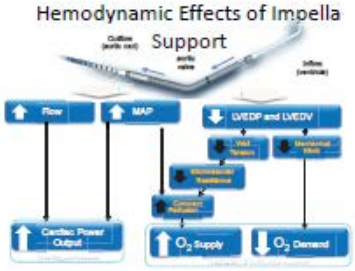



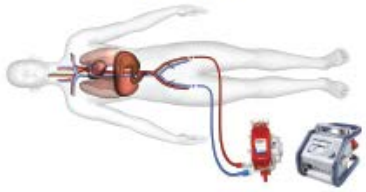


# Speaker Presentations

**Cardiac**
Joseph S. Meltzer, MD

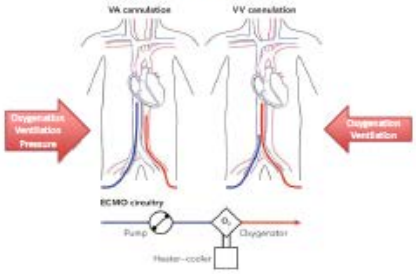
VA-ECMO



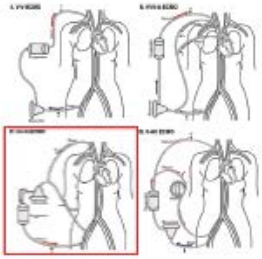
Something we rarely do at UCLA


Something we should consider


VA vs. VV ECMO




ECMO does come in other flavors



This is VA-ECMO


What are the components of the ECMO Circuit?

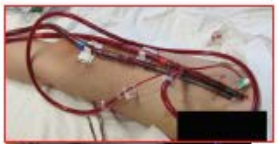
ECMO SYSTEMS

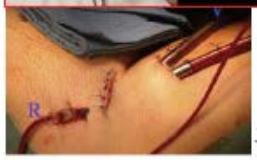
- Tubing/cannula - Artificial blood vessels
- Pump - Artificial heart
- Oxygenator - Artificial lung
- Feedback systems – pressure/flow transducers, monitors, bubble detector.

The Venous and Arterial Cannulae

18-26 French venous cannula
50-100 centimeters

14-20 French arterial cannula
18 centimeters





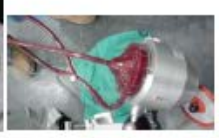

VENOARTERIAL FEMORAL CANNULATION

- Distal limb ischemia
  - Caused by near-total occlusion of the femoral artery by the cannula
  - Confirm presence of pedal pulse/flow by doppler after cannulation
  - Treatable with a catheter in the distal femoral artery attached to the arterial line of the ECMO circuit.

Pump Types

**Occlusive Roller Pumps**
- Positive displacement
- Resistance-independent
- Hemolysis

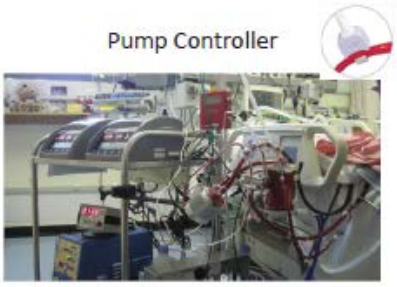
**Constrained vortex pumps**
- Centrifugally generated pressure differential
- Resistance-dependent

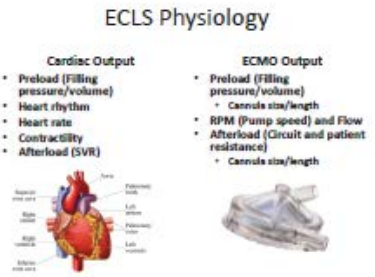


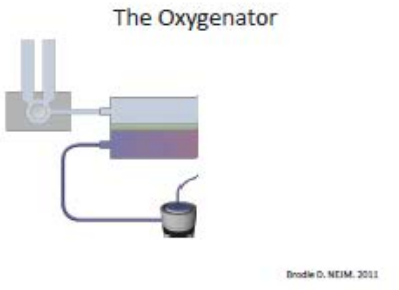
# Speaker Presentations

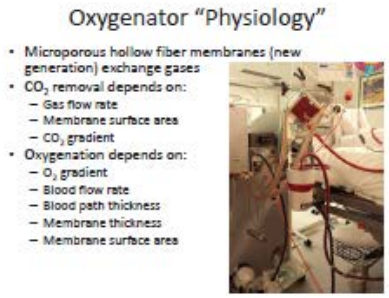
**Cardiac**
Joseph S. Meltzer, MD



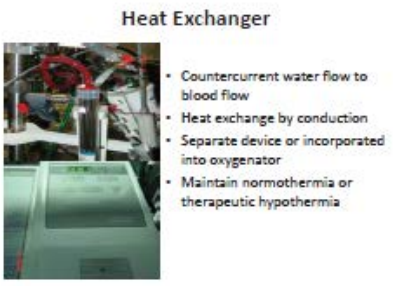


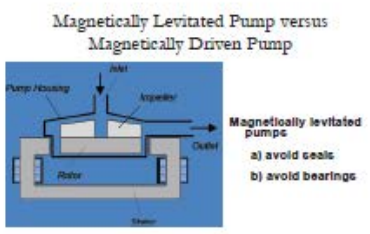



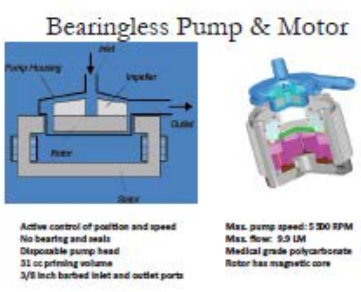











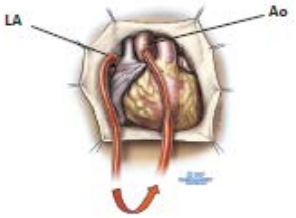



# Speaker Presentations

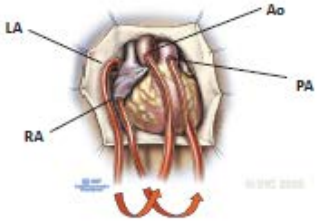
**Cardiac**
Joseph S. Meltzer, MD

Primary Console Control Panel

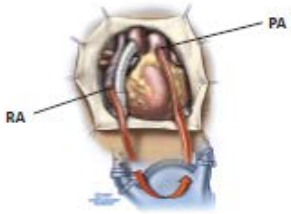

Left Heart Cannulation




Bilateral Support




Right-side Support with HeartMate XVE LVAD

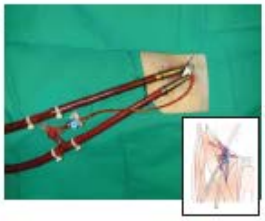



Percutaneous Cannulation

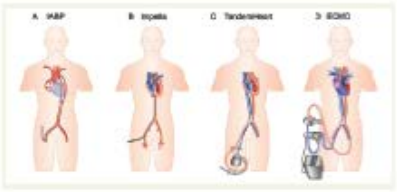
Generally Femoral vein to Femoral artery

In adults 19-21 Fr venous drainage cannula and 19-21 Fr arterial return cannula

5Fr distal arterial cannula



So which to choose?



# Speaker Presentations

**Liver Support and Liver Replacement: Ready for Prime Time?**
Gebhard Wagener, MD

**Update on Devices for the Failing Organ in the ICU: "Liver support and liver replacement: ready for prime time?"**

*Gebhard Wagener, MD*

Department of Anesthesiology

Columbia University, New York, NY

Unlike for most other organ systems there has been no workable and established alternative to transplantation for the treatment of liver failure. Multiple different systems have been developed to support the liver in case of deteriorating function. Ideally such a system would take over the many functions of the liver while the damaged organ either recovers or a transplant becomes available. This is only feasible in case of acute of subacute liver failure. The most common clinical scenario is acute liver failure for example due to intoxication or due to graft failure after transplantation. Liver support systems have been studied mainly in patients with acute and hyperacute liver failure with up to 4 weeks between onset of jaundice and encephalopathy. These patients often rapidly deteriorate and may need a transplant before irreversible neurological complications occurs. Due to the paucity of available organ a substantial number of these patients may die on the waitlist. However if supportive therapy is successful and no neurological complications come about, the liver may fully recover without a transplant.

Basically liver support systems that have been developed are either cell-based not cell-based.

Cell-based, bio-artificial liver support systems use either human hepatoblastoma cells or porcine hepatocytes. The cells are contained in a hollow-fiber bioreactor. The theoretical advantage of a bioartificial liver is that it may take over most metabolic and synthetic functions of the liver. However technical difficulties and disappointing outcome studies have prevented the development of a fully functional biortificial liver. Most notable the HepatAssist™ system, one of the most advanced systems that uses porcine liver cells failed to demonstrate a survival benefit in a phase III trial of patients with fulminant hepatic failure. A different bioartificial system (ELAD™) that uses cloned human hepatocytes derived form hepatoblastoma cells is under investigation.

The main non-biological systems are:

- Single-pass albumin dialysis (SPAD)
- Molecular adsorbent recirculating system (MARS™)
- Fractionated plasma separation and adsorption system (FPSAS-Prometheus™)

SPAD consists of a modified CVVHD circuit with a regular dialysis filter, however the dialysate contains albumin and therefore allows the removal of protein bound toxins. This system is very simple and easily used even with conventional CVVHD machines.

MARS also uses the principle of albumin dialysis but the instead of discarding the dialysate MARS recirculates the albumin dialysate past a second filter that removes water-soluble toxins. The dialysate then passes an anion exchanger (to remove negatively charged toxins) and a charcoal adsorber before returning to the first filter.

# Speaker Presentations

**Liver Support and Liver Replacement: Ready for Prime Time?**

Gebhard Wagener, MD

In both SPAD and MARS the first filter is impermeable for albumin and therefore only free fractions of toxins can be removed. Multiple studies of MARS have demonstrated safety and an improvement in symptoms but no change in mortality.

The Fractionated plasma separation and adsorption system (FPSAS-Prometheus™) separates albumin through an albumin-permeable filter. The separated albumin in the secondary circuit then passes a resin adsorber and an anion exchanger. The cleaned albumin fraction reenters the primary circuit and then undergoes conventional high-flow dialysis to remove water-soluble toxins. FPSAS is well tolerated and similar to MARS improves symptoms without affecting mortality. Treatment for both MARS and FPSAS takes about 6 hours after which the adsorbers are exhausted.

High-volume plasma exchange (HVP) that removes patient's plasma (about 15% of ideal body weight per day) and replaces it with fresh frozen plasma is another modalities that is used to teat acute liver failure. A recent large randomized trial of 182 patients with acute liver failure demonstrated a transplant free survival with the use of HPV.

Unfortunately most liver support systems that have been studied are complex, expensive and failed to improve outcome even while improving symptoms. High-volume plasma exchange may be a better and more promising alternative to support the liver on the way to recovery or transplant.

# SOCCA 29th Annual Meeting and Critical Care Update
# Continuing Medical Education (CME) Activity Information

**Activity Overview**
The Society of Critical Care Anesthesiologists (SOCCA) 29th Annual Meeting and Critical Care Update is designed to optimize outcomes for critically ill patients and their families through evidence-based and clinically-oriented physician education. The purpose of the SOCCA Annual Meeting and Critical Care Update is to advance knowledge, improve competence, and enhance performance of intensive care teams.

**Target Audience**
The SOCCA 29th Annual Meeting and Critical Care Update is designed for anesthesiologists in the clinical and laboratory setting.

**Educational Objectives**
As a result of participating in this live CME activity, learners will be able to:

- Evaluate the current state of emerging knowledge and practice patterns and assess the relevance to their professional practice;
- Incorporate new knowledge from advances in anesthesiology practice into their professional practice areas; and
- Distinguish gaps in their knowledge, behavior, and patient outcomes that may result in a need for additional education and training.

**Accreditation Statement**
This activity has been planned and implemented in accordance with the accreditation requirements and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of the International Anesthesia Research Society (IARS) and the Society of Critical Care Anesthesiologists (SOCCA). The IARS is accredited by the ACCME to provide continuing medical education for physicians.

**CME Credit**
The International Anesthesia Research Society (IARS) designates this live activity for a maximum of 6 *AMA PRA Category 1 Credits.*$^{TM}$ Physicians should claim only the credit commensurate with the extent of their participation in the activity.

**Claiming CME Credit**
The IARS will provide online program evaluation and session tracking to support claiming CME credit immediately following the close of the live activity.

**Disclosure**
The International Anesthesia Research Society (IARS) makes every effort to develop CME activities that are independent, objective, scientifically balanced presentations of information. The IARS has implemented mechanisms requiring everyone in a position to control content to disclose all relevant financial relationships with commercial interests. Relevant financial relationships are defined as financial relationships in any amount occurring within the past 12 months, including financial relationships of the spouse or partner of the person in control of content. Disclosure of any or no relationships is made available in advance of all educational activities. The IARS evaluates, and if necessary, resolves any conflicts of interest prior to the start of the activity. Individuals who refuse or fail to provide the required disclosures are disqualified from being a planning committee member, teacher, or author of CME, and cannot have control of, or responsibility for, the development, management, presentation or evaluation of the CME activity.

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| | |
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***Course Faculty, Moderators, Reviewers, and Abstract Authors/Presenters Disclosures***
The following course faculty, moderators, reviewers, and poster authors/presenters indicated having relevant financial relationship(s) with the following commercial interests:

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| Stefan J Schaller, MD | Bayer AG, Siemens AG, GE, Merck & Co, Inc., Rhoen-Klinikum AG and Fresenius SE | Ownership Interest |
| Daniel Talmor, MD, MPH | Intensix | Ownership interest |

The remaining course faculty (i.e. moderators, reviewers, abstract authors/presenters, etc.), and all other individuals in a position to control CME content for the SOCCA 29th Annual Meeting and Critical Care Update have reported **no relevant financial relationship(s)** with any commercial interests related to the content of this educational activity.